COMPTON'S

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AND

FACT-INDEX

INTERESTING · ACCURATE · UP-TO-DATE

To inspire ambition, to stimulate the imagination, to provide the inquiring mind with accurate information told in an interesting style, and thus lead into broader fields of knowledge—such is the purpose of this work

VOLUME 12

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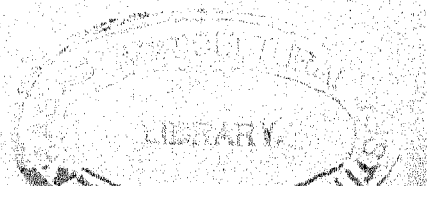

Here and There in This Volume

AT ODD TIMES when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. With this as a guide, you may visit far-away countries and watch people at their work and play, meet famous persons of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list is not intended to serve as a table of contents, an index, or a study-guide. For these purposes consult the Fact-Index and the Reference-Outlines.

For the Reading and Picture Hour

Parent and Child; School and Home

High Lights in History's Pageant

Some Famous Men and Women

Travel-Views of Lands Across the Seas

HERE AND THERE IN THIS VOLUME

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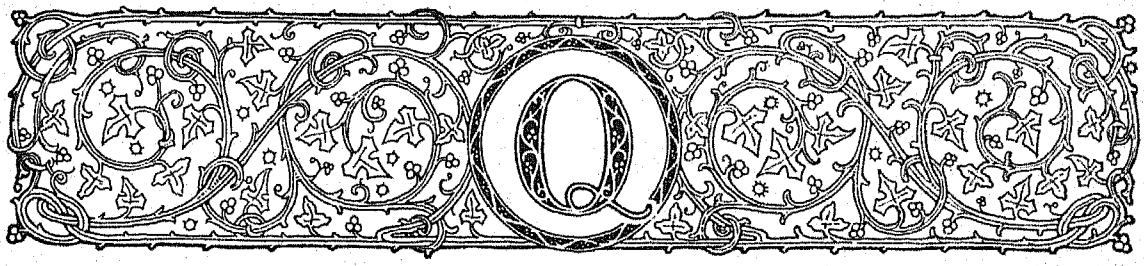
Interest-Questions Answered in This Volume

Key to Pronunciation

Pronunciations have been indicated in the body of this work only for words which present special difficulties. For the pronunciation of other words, consult the Fact-Index. Marked letters are sounded as in the following words: *cāpe, ăt, fär, fȧst, whạt, fạll; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, dọ; cūre, bŭt, rụde, fụll, bûrn; ü* = French *u*, German *ü; ġem, ḡo; thin, ~~th~~en; ṅ* = French nasal (*Jeaṅ*); *zh* = French *j* (*z* in *azure*); *κ* = German guttural *ch*.



QUAIL. One of the few birds that are benefited by the coming of the farmer is the quail. Cultivated fields mean more weeds and insects, and so more food for him. In the destruction of these pests he is the farmer's ablest co-worker. The bird's delicious flesh and his swift flight make him a great favorite with sportsmen. Many states have established preserves where the birds may multiply. The state will stock a farmer's land with a colony of quail on condition that he will allow no hunting for an agreed period. The hunting season is usually restricted to a few weeks in the fall, to prevent the extermination of the birds.

FRIENDS OF THE FARMER

The glossy black crest of the California quail, above, is worn by both male and female. Below, a covey of young bobwhites crouch in typical ring formation, bodies close-packed, heads facing outward.

There are several species of American quail, varying in length from 9½ to 11 inches. The most familiar is the bird known in the North as the bobwhite, and in the South as the partridge. He names himself with his loud, clear, questioning call—*bob-white? bob, bobwhite?* This is an eastern bird, breeding as far west as Colorado. California and mountain quail are found in the humid districts of the Pacific coast. In the arid Southwest are Mearns's, Gambel's, scaled, and valley quail. Two species of Old World partridges, closely related to the American quail, have been successfully introduced in the Northwest and Middle West. These are the blue-gray European, or Hungarian, partridge from central Europe and the chukar partridge from India.

The plumage of the quail—mottled brown and buff in the female and black and white in the male—makes them almost invisible when they lie quietly in the field. (For illustration in colors *see* Birds.) Trusting to this concealment they will squat motionless until one is on the point of stepping on them. Then they take wing with an explosive whir. They nest in open, brushy fields where they can find good cover. The nest, well hidden in thick grass, holds 12 to 18 white eggs. The chicks leave the nest immediately after hatching, but the family keeps together in a covey until the following spring. When scattered they are brought together by the rallying call of the parents. At night the birds sleep on the ground in a circle, bodies packed closely together and heads facing outward, so that they can scatter instantly at an alarm. They do not migrate, but take to the woods in the winter.

Quail and partridges belong to the family *Perdicidae*. The true partridges, native to Europe and Asia, belong to the sub-family *Perdicinae;* the American quail to the sub-family *Odontophorinae*. Scientific name of bobwhite, *Colinus virginianus;* scaled quail, *Callipepla squamata;* California and valley quail, *Lophortyx californica;* Gambel's quail, *Lophortyx gambeli;* mountain quail, *Oreortyx picta;* and Mearns's quail, *Cyrtonyx montezumae;* Hungarian or European partridge, *Perdix perdix;* chukar partridge, *Alectoris graeca*.

QUARRYING. Throughout the centuries quarrying of stone has been done with hand tools, as it still is to some extent; but machines operated by steam and electric power are now common, especially in the United States. A visitor to a modern quarry finds "channeling" machines chugging back and forth on their short tracks cutting furrows in the solid rock, enormous cranes and derricks swinging huge blocks from place to place, and light railways laid here and there on the rough quarry bed to haul out the stone and carry off the strippings and refuse. Occasionally there is heard a mighty explosion, followed by a shower of splintered rock, and always the air is filled with the unmusical sound of thudding drills and heavy

hammers wielded by brawny arms. Rectangular masses of stone weighing many tons are loosened from the mother rock, great cranes swing them onto cars, and these are carried to the stone mill. There the stone is cut by saws of various types—swinging gang saws with chisel-like teeth, diamond-dusted circular saws and flat iron bands or steel cables fed with a mixture of hard sand and water. Then by planing machine, lathe, or hand carving, the stone is finished and perhaps polished.

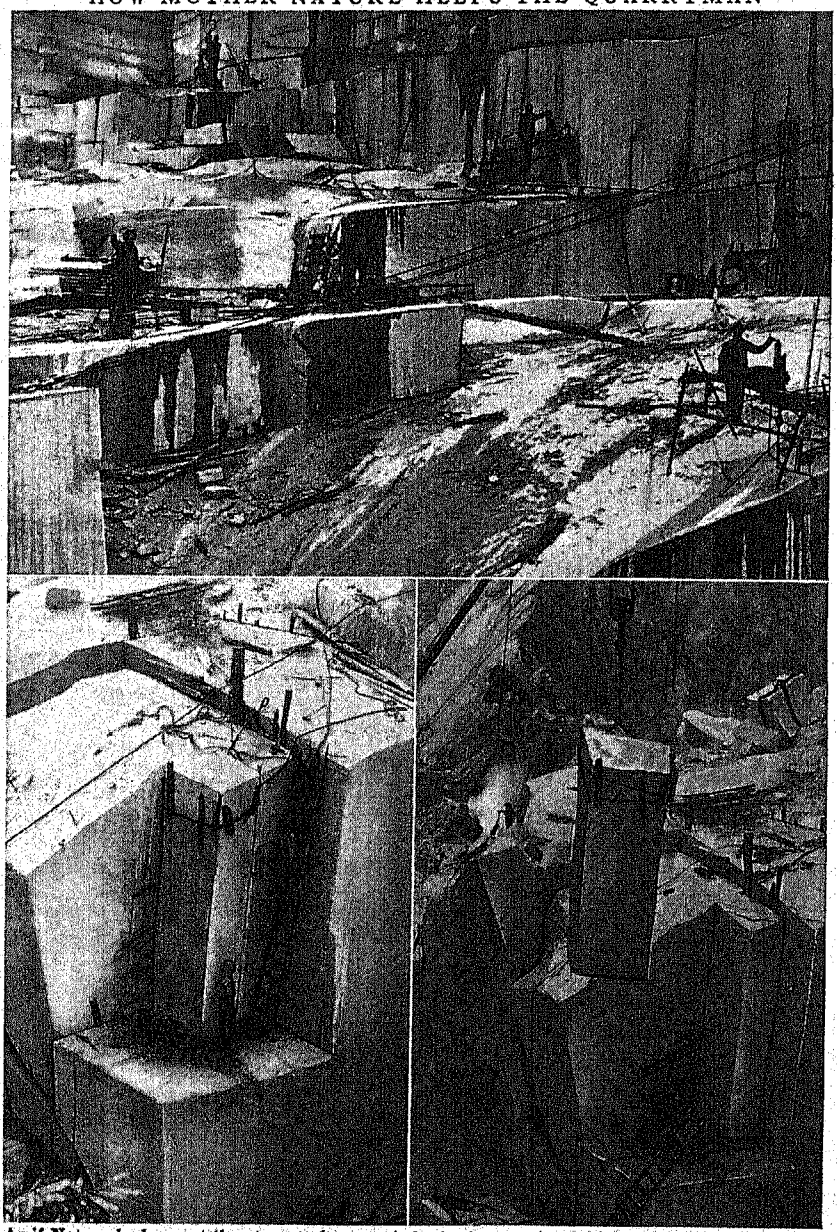
Popular Building Stones

The building stones most widely used are roughly classed as limestones, sandstones, granites, marbles, and slates. Oölitic limestone has a fish-roe texture. Commercial granite includes an assemblage of metamorphic rocks, such as schists and gneiss, and the igneous rock called granite. Limestone and sandstone are formed by the deposition of sediments by water, and are the most easily quarried because of their definite layers of stratification. But granite and other massive crystalline rocks also have natural jointings and lines of easy cleavage.

The "plug and feather" method of quarrying is the one principally employed in working by hand. A row of holes is drilled a few inches apart along the line at which it is desired to break the stone. In each hole are placed two "feathers"—flat pieces of steel rounded on one side to fit the curve of the hole. Then a narrow wedge called a "plug" is driven between the "feathers." By striking in succession all the plugs in the row, the splitting force becomes great enough to rupture the rock. This method is often used also in machine-worked quarries to separate large blocks after they have been cut vertically by the steam-driven "channeling" machines. Explosives, placed in holes drilled vertically in a row and exploded simultaneously, are commonly employed for detaching large blocks of stone. High explosives, such as dynamite, are often used when the rock is to be crushed into fragments for road work, concrete making, etc.

The channeling machine, which has found its greatest use in the United States, is like a small locomotive traveling back and forth upon a short track which is pinned to the solid rock. As it travels it strikes on one or both sides of the track with sets of long chisels set at different angles; these vibrate up

HOW MOTHER NATURE HELPS THE QUARRYMAN



As if Nature had meant the stone to be quarried, she frequently divides up rock masses as she has done in this Vermont marble quarry. First come the horizontal divisions, made in the laying down of the strata in the rock mills of the sea ages ago. Later come the vertical divisions made by the cracking of the rock when the earth's crust was upheaved or depressed. Thus great blocks can often be separated by merely driving in wedges, as you see in these pictures.

and down cutting a channel about 1½ inches wide and 4 to 10 feet deep, parallel to the rails on which the channeler moves. Since the channeler makes only vertical cuts, the rock must later be lifted from its bed by blasting or the "plug and feather" method.

The United States stands second to Italy in the production of marble, most of which comes from Tennessee and Vermont. Stone is used principally for building, monuments, paving and curbing, and in crushed form for roads, concrete making, and railroad ballast. Much limestone of inferior quality is used in making lime and in charging iron furnaces. Eighty per cent of the building limestone of the country comes from two counties in Indiana, near the cities of Bedford and Bloomington.

QUARTZ. The two commonest chemical elements in the earth's crust, oxygen and silicon, combine to form quartz. This is the most abundant of all minerals except feldspar (*see* Feldspar). Most sands are broken-down and waterworn fragments of quartz. Sandstone and quartzite are the same materials built up into rock again. Quartz is also an important constituent of granite. (*See* Granite; Sand.)

Quartz is hard enough to scratch glass, but not as hard as diamond, sapphire, or topaz. It occurs in very finely crystalline masses (flint, jasper, agate, etc.), and also as larger crystals often beautifully colored by impurities, including many of the semi-precious stones (*see* Crystals; Silicon). Quartz, quartz sand, and sandstone are used for making sandpaper and other abrasives, such as grindstones, polishing powder, soaps, etc.; for building materials and for refractories or heat-resisting materials; for making paint, glue, and for small bearings for axles of fine machines.

Clear natural quartz, called rock crystal, is valued for optical instruments. Because it is worked with difficulty and because it is rarely found in large pieces, science has learned how to make fused quartz, by melting fragments of natural quartz in the electric furnace.

Fused quartz shows virtually no expansion or contraction under changes in temperature, making it valuable for mirrors and lenses that must remain accurate in widely varying conditions, such as those used in telescopes; also for condensing lenses in motion-picture machines, where the heat of the high-intensity arc light often breaks glass. It is one of the best electric insulators known. As clear as air itself, it transmits heat rays, light, and ultra-violet rays better than any form of glass. Mercury-vapor lamps with tubes of fused quartz are powerful sources of the ultra-violet radiation used in medicine. Rays, visible or invisible, entering one end of a fused quartz rod will for the most part follow the rod around a right-angle turn instead of coming out through the sides, so that light can thus be actually "piped around corners."

Where OLD FRANCE *Still* LIVES *on in* MODERN CANADA

QUEBEC (*kwē-bĕk'*), CANADA. If you were suddenly dropped into the Province of Quebec, the oldest and largest of the Canadian provinces, you might almost believe that you were in France. Most of the people are of French descent and they have preserved their language, their Catholic religion, and their customs. But the province is much larger than France, occupying all of the great peninsula of eastern Canada lying between Hudson Bay and the Atlantic Ocean, save for the Labrador triangle along the Atlantic coast. Its area, which was doubled in 1912 by the annexation of the immense northern territory then known as Ungava, is about equal to the area of France, Belgium, Spain, England, and Norway combined. About 2,270,000 of the people, nearly 80 per cent, are of French descent. During the century and a half that these peasant-farmers have been a part of the British Empire, they have kept themselves separate from the English-speaking population. Even when they intermarry with other races, it is the others who lose their identity, as in the case of the Indians, Irish, and Celtic Scotch, who have been absorbed.

Extent.—North to south, greatest distance, 1,225 miles; east to west, 982 miles. Area, 594,534 square miles (71,000 water). Population, 2,874,255 (of French descent, about 2,270,000).

Natural Features.—Rolling country and Notre Dame Mountains south of St. Lawrence (highest point, Jacques Cartier Peak, 4,300 feet); level lowlands of St. Lawrence valley; wooded Laurentian Plateau (1,000 to 2,000 feet) occupying all the remainder of the province. Lakes: St. John, Mistassini, Albanel, Minto, Payne, Clearwater, Seal, Apiskigamish, Kaniapiskau, Memphremagog, and many others. Rivers: St. Lawrence and its tributaries Saguenay, St. Maurice, and Ottawa; Nottaway, Rupert, Big, Great Whale, Leaf, and Koksoak, tributary to Hudson Bay and Strait.

Products.—Corn, hay and other forage, oats, barley, wheat, tobacco, apples and other fruit; maple sugar and syrup; cod and other fish, lobsters; live stock, butter and cheese, poultry, honey; furs; asbestos, cement, copper, limestone, clay, zinc; lumber; textiles, pulp and paper, shoes, machinery, railway cars, flour, meat.

Cities.—Montreal (818,577), Quebec (capital, 130,594), Verdun (60,745), Three Rivers (Trois Rivières), Hull, Sherbrooke.

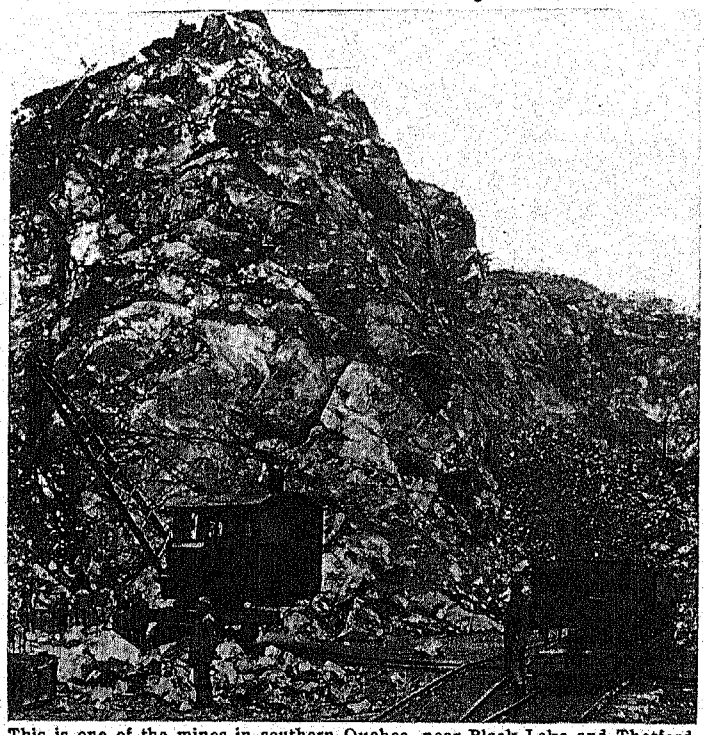
Most of these French-Canadians live along the St. Lawrence River. The strip of 50,000 square miles which lies south of the river, the "Eastern Townships," was originally inhabited in part by descendants of English Loyalists who fled from the United States at the time of the American Revolution, reinforced by subsequent immigrants from Britain and the United States. To the north the land is a great sparsely inhabited plateau, dotted with many lakes and bearing immense forests of red pine and spruce. This is the region which makes lumbering the second most important industry of Quebec; here, too, are to be found most of the mineral deposits —stone, clay, zinc, silver, copper, lead, gold, and iron. The mines which furnish two-thirds of the world's supply of asbestos are in the "Serpentine Belt" of volcanic rock between the city of Quebec and the Vermont line.

But the leading industry of the province is agriculture. This is carried on very differently from

farming on the great plains of the central provinces, for most of the farms in the older cultivated districts of Quebec are small, and they are frequently not more than 30 rods in width, stretching back perhaps a mile in length from the river or road on which they front. This brings the houses close together and makes the countryside one of the most picturesque in the New World, appearing as a long line of small white houses, with curved red roofs, and ribbon-like strips of land stretching away behind. The chief reason for this curious arrangement of the land is that the Frenchman is socially inclined and likes to have people near him.

On these fertile farms the French-Canadian families, which often number from 10 to 14 children, raise hay, potatoes, oats, barley, with some wheat, and corn near Montreal. In the country around Montreal one of the principal crops is a strong-smelling variety of tobacco, which is grown in nearly every farm and garden.

AN ASBESTOS MINE IN QUEBEC



This is one of the mines in southern Quebec, near Black Lake and Thetford, which provide the world's principal supply of asbestos. The crane scoops out the asbestos rock, and swinging around lowers it into cars, to be taken to the breakers.

On some farms may be found orchards of apples, pears, and plums, but most of the fruit, especially the famous snow apple, with its scarlet skin and snowy meat, is grown near Montreal and in the "Eastern Townships," where are also large stock farms and dairies producing each year millions of dollars' worth of butter and cheese.

In the cities also—notably in Montreal, the largest city, and in Quebec, the capital—the French predominate, but the industries—the shoe factories, lumber mills, iron works, pulp mills, wool and cotton factories, and the railroads—are chiefly in the hands of the Englishmen or the canny Scotch.

The province has a bracing and healthful climate, with long cold winters rendered tolerable by the dryness of the air. The winter sports of Quebec and Montreal are famous and attract thousands of visitors every year. In the north the average temperature for the year is about 12 degrees lower than in the south. The St. Law-

A WOOD PILE READY TO BE TURNED INTO NEWSPAPERS

What a wood pile! Spruce logs, cut into lengths of two to four feet, are here piled up ready to be ground into pulp for paper. A large amount of the pulp for American newspapers is imported from Canada, and England also gets much of its paper from the same source. Quebec stands first among the Canadian provinces in output of wood pulp.

A FINE HERD OF QUEBEC CATTLE

Stock raising is one of the important industries of Quebec, and on much of the land neighboring the New England states stock raising and dairying are more extensive industries than farming.

rence, the gateway to Canada, and a magnificent system of smaller rivers and lakes abound in picturesque and noble scenery, and are of great economic importance, furnishing cheap transportation routes and limitless water-power.

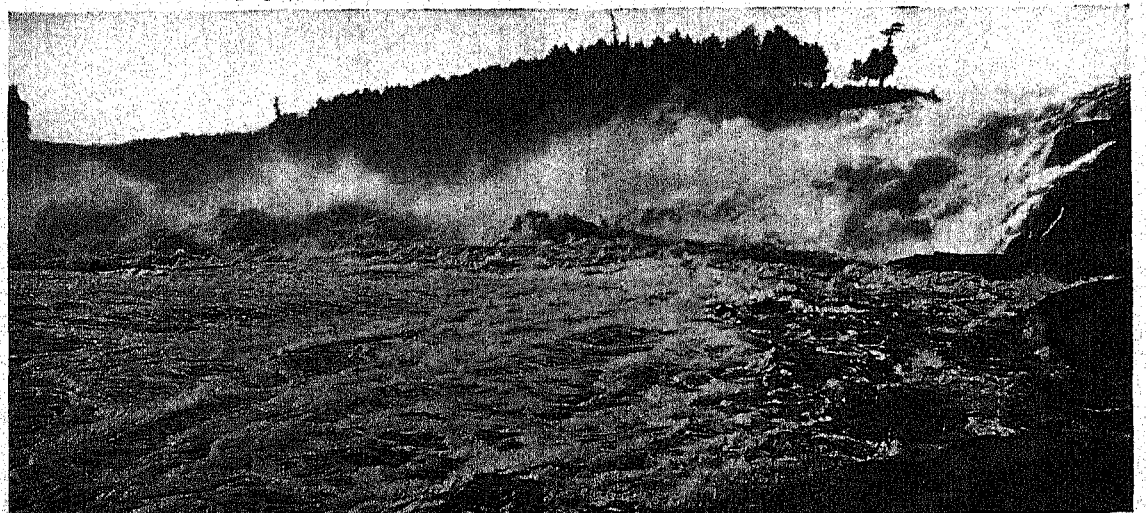
The province maintains an excellent system of public schools. The elementary schools are administered by a council of public instruction, which is divided into two committees, one to manage the Roman Catholic schools and one for the Protestant institutions. Each taxpayer may choose to which group of schools his taxes will go, and the government grants are divided between the groups on the basis of population. There are three large universities, McGill, Montreal, and Laval.

The province of Quebec has a long and romantic history, beginning in 1534, when Jacques Cartier entered the St. Lawrence River. Its settlement dates from 1608, when Champlain founded the city of Quebec. For more than a century and a half the province remained under the dominion of France and was known as New France. England finally obtained possession of it by the victory of Wolfe over Montcalm, in 1759 (*see* French and Indian War).

At times the existence of this "nation within a nation" has led to serious difficulties. In 1837 there was a short-lived rebellion of French-Canadian peasants under the leadership of Louis Joseph Papineau. The rebellion failed, but it led in 1840 to the union of Quebec and Ontario (then known as Lower and Upper Canada) as the Province of Canada. This union continued until 1867, when the Dominion of Canada was formed. Quebec remained a stronghold of antifederal sentiment, but the development of national ties brought a gradual decline of the separatist movement. The old racial feeling reasserted itself in opposition to conscription during the first World War, and during the second World War also there were some who objected to the policy of aiding Great Britain. But in both wars the majority of the people of the province contributed notably to Canada's splendid achievements at home and in the field.

A decision of the British Privy Council in 1927 placed the boundary between Labrador and Quebec along the watershed of the rivers flowing to the Atlantic. By this decision, Quebec lost to Newfoundland an area of 112,400 square miles (*see* Labrador). It still remains, however, by far the largest of the Canadian provinces. (*See also* **Quebec** in FACT-INDEX.)

POWER TO TURN A MILLION WHEELS



We are here looking at the Shawenegan Falls 70 miles northeast of Montreal in the River St. Maurice. This river has a remarkable flow of water, and the power derived from these falls, which are one of the largest in the river's course, helps to grind up into pulp and later to make into paper such spruce logs as those shown in the picture on the opposite page.

Historic Quebec, the Sentinel of the St. Lawrence

QUEBEC, CITY OF. Few cities of the New World can vie in romantic charm with the city of Quebec. As the traveler approaches on the bosom of the majestic St. Lawrence, he first sees the frowning mass of Cape Diamond upreared against the sky. Long dark lines ridging the summit, 333 feet above the river, betray the position of the massive fortifications of its citadel.

As the visitor comes nearer, he sees that the city is built in two sections—an Upper Town, separated by massive walls about half-way up the bluff, and the quaint old Lower Town, with straggling streets fringing the water front on a narrow strip below. The frowning city walls (Quebec is the only walled city in America) and the ancient cobblestone buildings of the Lower Town make it look like a city of medieval France, dropped down on the banks of the St. Lawrence. The resemblance is heightened when one enters the city, for nine-tenths of the inhabitants are of French origin, and French is the language of everyday life.

No other city north of the Rio Grande preserves unchanged so many features of the life of a bygone age. Wherever you turn you see nuns and priests in the costumes of two centuries ago, and the pupils of the seminary still wear the long blue coat piped with white, with green sashes. The picturesque horse-drawn *caleche* or light carriage and the sleigh in winter have not yet entirely given way to the automobile; and the *habitants*, or French-Canadian peasants, who throng the markets still live and dress much as did their forefathers.

QUEEN OF NEW WORLD CITIES

"Unexampled for picturesqueness and magnificence of position on the American continent, and for the romance of her historic associations, Quebec sits on her impregnable heights a queen among the cities of the New World.

"At her feet flows the noble St. Lawrence, the fit highway into a great empire, here narrowed to a couple of miles' breadth. From the compression of the great river at this spot the city derives its name. On the east of the city, along a richly fertile valley, flows the beautiful St. Charles, to join its waters with those of the great river. The mingled waters divide to enclasp the fair and fertile Isle of Orleans.

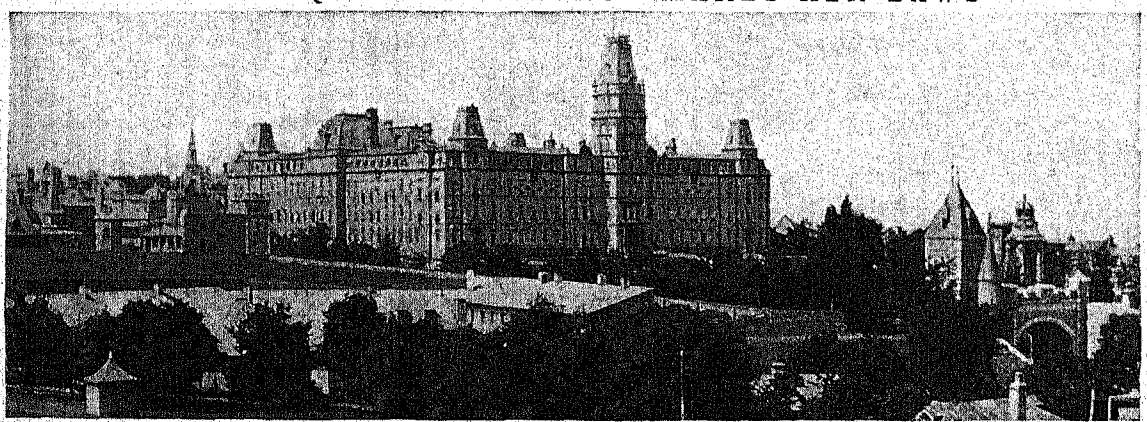
"The city, as seen from a distance, rises stately and solemn. Clustering houses climb the rocky heights. Great piles of stone churches, colleges, and public buildings, crowned with gleaming minarets, rise above the mass of dwellings. Above all rise the long dark lines of one of the world's famous citadels, the Gibraltar of America."

—CHARLES MARSHALL.

The Upper Town contains the more fashionable shops, residences, parks, churches, and fine public buildings. Conspicuous among the latter are the buildings of the provincial parliament and various government departments, for Quebec is the capital of the province which bears the same name. For 150 years of French rule and upward of 30 of British dominion it was also the capital of Canada. On the heights are the seminary of Quebec and Laval University, the seat of French learning and culture in the New World. Some of the seminary buildings date from the latter half of the 17th century. Many splendid old churches and convents, famous for their treasures of paintings and relics, remind the visitor of the religious zeal which played so large a part in winning the New World for civilization. One of the most famous of these, the Basilica or French Cathedral, begun in 1647, was destroyed by fire in 1922, but has been rebuilt. In the nave of the Ursuline Convent chapel (1639) repose the bones of the Marquis de Montcalm.

Much of the commercial life of the city still centers in the narrow strip of land at the foot of the cliff. Steep and winding streets, flights of stairs, and an elevator connect the two parts. Along the water's

WHERE QUEBEC PROVINCE MAKES HER LAWS



The Parliament Buildings of Quebec are worthy of the great province they adorn. They are situated on the Grande Allée, one of the principal thoroughfares of Quebec, notable for its fine buildings, and are surrounded by extensive and attractive grounds. They form a square, 300 feet on each side, with towers at the corners.

MAGNIFICENT CHATEAU FRONTENAC ON DUFFERIN TERRACE

One of the most magnificent hotels in all the world is the Chateau Frontenac, built in the style of a French chateau, on Dufferin Terrace in the city of Quebec, overlooking the picturesque St. Lawrence River.

edge are miles of wharves and docks, for Quebec was long the chief port of Canada. It is not the commercial center that it once was, however, for the western development of the country transferred most of the export trade of the province to Montreal. But now, as the ocean-going vessels increase in size, it becomes more difficult for them to ascend the river, which at Quebec narrows to about a mile in width, and this is bringing some of the commerce, especially in lumber, back to Quebec. The great passenger liners also tend to make Quebec their terminus.

An Eventful History

Quebec is rich in memories of the shadowy past, beginning with the visit of the navigator Jacques Cartier, in 1535, who found several tribes of Indians encamped there. Nearly 75 years later another bold Frenchman, Samuel de Champlain, founded the first settlement below the commanding heights, which became the stronghold first of French power in America, and later of British. Quebec finally passed into British hands after the memorable campaigns in 1759 (*see* French and Indian War). One of the historic spots visited by every traveler is the Plains of Abraham, where a monument commemorates the heroic Wolfe, who fell in the hour of his victory. In the Governor's Garden is a common monument to both Wolfe and the no less heroic French commander Montcalm, who received his death wound within a few minutes of his rival. British genius for government is nowhere better revealed than in the liberty which has been allowed to the French people of this ancient city and the province, by which they retain their language, religion, and customs, remaining as a bit of old France in the heart of British Canada. Population, 130,594.

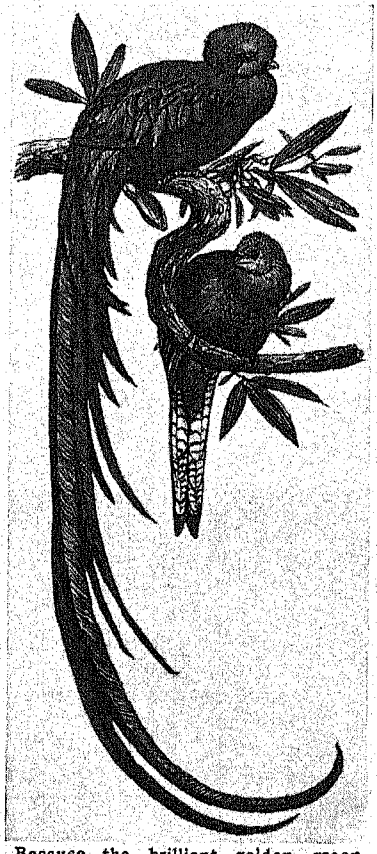
QUEENSLAND, AUSTRALIA. The entire northeastern portion of Australia, 670,500 square miles, is included in this state. The population is extremely scanty, about 950,000, or slightly more than one person for every square mile. Ninety-three per cent of the area is still the property of the Crown, though part of it is leased for grazing. Only about one acre out of 400 is under cultivation. Corn, wheat, and sugar cane are the most important crops. Silver, gold, coal, and other minerals are mined, and considerable quantities of timber are cut from the immense forests which cover much of the state; but lack of labor has prevented the adequate development of these abundant resources.

More than half of Queensland lies within the tropics. The winter, which is practically rainless, is about as warm as an English summer. The summer, when the heavy rains occur, is considerably warmer, but extremes of temperature are practically unknown. Most of the northern coastland is tropical forest, with luxuriant palms, tree ferns, bamboo, and screwpine. Pineapples, bananas, and other tropical fruits are raised. Farther inland, where rainfall is

scanty, are the grassy lands with their famous sheep-walks and cattle-runs. More than a third of the cattle in Australia are in Queensland, and the dairying industry is rapidly growing. Manufactures are still of comparatively little importance. Brisbane, the capital, with a population of more than 300,000, is the only city of any considerable size. It is an important shipping point and is the seat of a university established in 1911. (*See* Australia.)

QUETZAL (*kĕt-säl'*). For gorgeous plumage few birds surpass the quetzal of Central America and Mexico, the national bird of Guatemala. The male, hardly as large as a mourning dove, has tail coverts elongated into a golden green train more than three feet long. His underparts are crimson; the rest of his plumage brilliant green. The less colorful female lacks the long tail plumes. Among the early Indian tribes of this region the quetzal was an emblem of royalty and religion. The privilege of wearing the bird's decorative plumes was granted only to chiefs and priests. Scientific name, *Pharomacrus mocinno.*

EMBLEM OF ROYALTY



Because the brilliant golden green plumage of the male Quetzal does not fade after death, as do the feathers of many birds, hunters have nearly exterminated this bird, whose feathers were once the emblem of royalty and religion.

QUINCE. Although a favorite fruit for jellies and preserves, to which it lends a delightful flavor, the quince when raw is bitter and puckery to the taste. The common quince (*Cydonia vulgaris*) is a many-branched shrub or small tree, closely related to the apple, with large white or pink flowers resembling apple blossoms, followed by hard golden yellow apple- or pear-shaped fruit. It is widely cultivated in various parts of the Northern Hemisphere. In the United States the best orchards are found in New York State. It is native to Persia and Anatolia, and possibly to Greece. It was familiar to the ancient Greeks and figured in their mythology. Representations of it are found in Greek statuary.

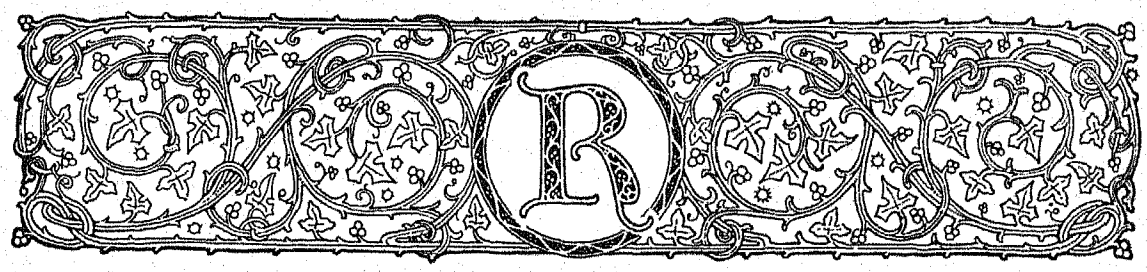
The Japan quince (*Cydonia japonica*) is grown in gardens for the beauty of its early spring flowers, which vary from creamy white to rich red. The fruit is green and fragrant, but uneatable.

QUININE (*kwī'nīn*). In 1638 the Countess of Chinchon, wife of the governor of Peru, lay ill with malarial fever. She was cured by a native Indian remedy, prepared from the bark of a tree called from that time on the "cinchona." Brought to Europe by Jesuit missionaries, the bark became known as Jesuits' bark, or Peruvian bark. Nearly 200 years later scientists proved that the bark owed its healing power to a chemical contained in it called quinine.

Quinine is usually extracted in the form of quinine sulphate by treating the powdered bark with lime, alcohol, and then sulphuric acid. Of the 40 species of cinchona trees, only a dozen are used to make the drug. Specimens of these were transplanted to the East Indies by the Dutch government in 1854 and the plantations of Java became the chief source of the world's quinine supply.

When the Japanese cut off this supply during the second World War, synthetic substitutes for treating malaria began to be manufactured on a large scale from coal tar. Most important of these was *atabrine*, first compounded by German chemists in 1933. Within a short time enough atabrine was being produced annually in the United States to treat 33 million cases of malaria. At first atabrine was intended merely to supplement quinine, but later it was found effective enough to render the world independent of the cinchona tree.

Quinine itself is one of a large group of compounds, called *alkaloids*, obtained chiefly from plants of the dogbane, legume, poppy, buttercup, madder, and potato families. All are bitter, colorless, and crystalline when purified. They contain carbon, oxygen, nitrogen, and hydrogen, and belong to the benzene group (*see* Chemistry). Morphine, belladonna, cocaine, atropine, and some others have valuable medicinal properties when employed in small amounts by a physician, but an overdose may cause death.



RABBIT. The term "rabbit" in popular usage is applied indiscriminately to all members of the family *Leporidae.* To most people "rabbits" and "hares" mean the same thing. Strictly speaking, however, the name rabbit belongs only to those animals which live in holes or burrows, and bring forth their young blind and hairless. Their ears and legs are shorter than those of hares, and they cannot run as swiftly. "Jack-rabbits" and "snowshoe rabbits" are not rabbits, but hares. The cotton-tail is the commonest American rabbit. Both hares and rabbits are rodents having relatively large bodies, short tails, hind legs longer than fore legs, and large front teeth, or incisors. (*See* Hares and Rabbits.)

RABELAIS, FRANÇOIS (*rä-be-lā', fräṅ-swä'*) (1493?–1553). The hearty, jibing, racy, and often most improper laughter of this famous French humorist rings in our ears even now, down four centuries of time. While pretending to tell a fairy tale about the adventures of two giants, Gargantua and Pantagruel, Rabelais makes huge fun of the vices and foolishness of the people about him, and of abuses within the church. His humor is at times so shocking, and his stabs at the church so deep, that it is hard to believe that he was almost all his life a member of the clergy.

Rabelais became a brother of the order of St. François in the convent of Fontenay-le-Comte in western France, about 1519, and pored over so many great volumes and learned so many strange languages that the other monks began to fear and suspect the young wiseacre. They charged him with heresy, and in wrath he whisked his monk's robes out the door and down the dusty highway, which led him on a long vagabondage. Though he still wore his pious costume and retained it all his life, we next find him at Montpellier—in the south—studying medicine, lecturing in the university there, and, in 1530, becoming physician of the hospital. And it seems doubtful if the church would any longer have influenced more than his costume, if he had not about this time won the friendship of Jean du Bellay, later made a cardinal. When Bellay went to Rome in 1534, Rabelais was a member of his retinue; the pope's pardon was granted him for his abrupt departure from the monastery; and later, also through the good offices of Bellay, he was given "livings" in the Church of France which lifted him above the fear of want. During a period of religious persecution in 1547, he fled to Metz, and as physician gained a humble fame among the poor. In 1552 he published his fourth book about Pantagruel, resigned his living and went to Paris, where he died the next year, murmuring, "I go to find the great *Perhaps.*"

The precise year of Rabelais' birth is not known. In his half-vagabond life he made the acquaintance of every tramp and trudging workman along the road, of the great men of the church, and of the king and his court. From such a life was distilled the wide sympathy with all men, the rowdyism, the cleverness, the liveliness which make his writings still read today.

Rabelais' great satire 'Gargantua and Pantagruel' was published in sections, the first of which appeared in 1533; the complete edition was first published in 1567. He also edited various works, including 'Medical Letters of Giovanni Manardi' (1532); a reprint of the 'Aphorisms' of Hippocrates (1533); 'Last Testament of Lucius Cuspidius' (1533); 'Marliani's Topography of Ancient Rome' (1534).

RACCOON. This interesting animal is a relative of the bear, though it is much smaller and does not greatly resemble the bear except in its manner of walking, which is "plantigrade"—that is, with all four feet resting flat on the ground. It is found in North America, especially in the southern part of the United States and along the Pacific coast. A species called the crab-eating raccoon is also found in parts of South America.

The common "coon" of the United States has a stout clumsy body, about two feet long without the tail, which is about a foot in length. The long coarse hair of the body is grayish-brown, and the tail is ringed with black and white. The head is broad with a pointed muzzle, and the face is crossed by a dark band which includes the eyes.

The home of the animal is usually high up in the hollow of a large tree; here it rests by day and hibernates through the severe winter weather. It is active at night, and during the season of young corn is very destructive to the green ears. Besides corn, its usual food is fish, crawfish, and various mollusks, though it also eats mice, insects, fruits, small birds, and eggs.

The raccoon makes an interesting pet, for it is intelligent and full of a restless curiosity that makes it examine every strange object with interest. A favorite trick is to search the pockets of its young master for nuts and other bits of food.

In early pioneer days raccoon fur was much used for coats, carriage robes, and especially the famous "coon-skin" caps on which the tails were often left hanging. This fur became less popular afterward, though it is now again come into fairly extensive use Scientific name, *Procyon lotor.*

"LITTLE BROTHERS OF THE BEAR"

Raccoons like to live near the water so that they can bathe, go fishing, and wash their food before eating it. The one in the top picture seems to be splashing around just for fun. Below a mother raccoon is carrying her young one as a cat carries a kitten. The mothers spend a lot of time teaching the little ones proper raccoon habits.

BLACKFACE FINDS OUT ABOUT HIS NEIGHBORS

The Story of a Young Raccoon

Bright black eyes saw everything

BLACKFACE was a little raccoon, and he lived in a hollow high up in a big tree. He had four little brothers and sisters. They lived in the hollow tree, too, and so did his father and mother.

The little raccoons looked just alike. Their faces were black and their noses were sharp. They had bright black eyes that saw everything that was going on around them. All of them had fine coats of gray fur and beautiful bushy tails with black rings around them clear to the very end.

Blackface was the liveliest in the family. He was full of mischief, and he liked to romp and play better than anything in the world. He was very curious, too, and he sometimes let his curiosity get him into trouble.

"Dear, dear!" his mother would often say. "I don't know what I am going to do with you, Blackface, if you don't learn not to meddle with things you do not understand. Ask all the questions you like, but don't be nosing and touching everything that comes along." This was very hard for Blackface to learn. Every time he saw anything new he always wanted to touch it or grab it with his slender little paw to find out what it was.

Another thing that was hard for him to learn was to sleep all day. His brothers and sisters lay on the floor of the den and slept the whole day through as their mother and father did; but Blackface was too lively for that. He liked to poke his little head out at the doorway and see what was going on in the forest. Most of all, he liked to climb down the tree and play around on the ground, though he did not do this very often because his father and mother would not let him.

"I don't see why we have to sleep in the daytime, when all the other creatures are awake," he said to his father one day. "Why do we, father?"

"It is the way raccoons have always done," his father told him. "We stay in our dens in the daytime to rest and sleep. At night we go out and hunt for our food. It is much the safest way."

Blackface didn't say anything more, but he still thought it was silly to sleep in the daytime when there was so much to see and do. He made up his mind that *he* would stay awake, no matter what other raccoons did.

So one summer afternoon, when his father and mother and brothers and sisters were fast asleep, Blackface very quietly slipped out of the den. For a moment he stood on a big branch, just outside the doorway, and looked about him. Then he started down the tree.

He went down head-first, as all raccoons do, digging his little sharp claws into the bark to keep from falling. Pretty soon he reached the ground.

"Now," he thought, "I will go wherever I like, and do whatever I please. This is a lot more fun than sleeping."

He started off through the woods. He hadn't gone far, when he heard a queer noise up in a tree. *Tap—tap—tap, tap—tap—tap.* Blackface looked up. He saw a bird tapping its long bill against a tree as hard as it could.

"I wonder why he's doing that," he thought. "I'd better try to find out." So he started up the tree.

The woodpecker was getting his dinner. He was very much annoyed at being interrupted and flew away with a loud scream. Blackface went right on climbing. "Maybe he will come back," he thought. "I'll just wait, because I *must* find out why he tapped like that."

Soon the woodpecker came back and flew very near to the little raccoon. "What are you doing in my tree?" he asked angrily. "Go away this minute!"

Blackface was surprised, but he was not frightened. He answered: "I just came up here to find out why you tapped on the tree like that."

"Go away! go away! I tell you!" the woodpecker screamed louder than ever. "Go away, or I will peck you with my bill!"

"I won't go away," Blackface said stubbornly, "until I have found out what I want to know!"

The woodpecker darted at him and pecked him on the head!

"Ouch!" cried Blackface. "That hurt!"

"Of course it did!" screamed the woodpecker; "and if you don't go away I will peck you again!"

Once more it darted toward him, and this time Blackface didn't wait a second. He turned and scrambled down the tree as fast as he could go.

"Dear me!" he said when he was on the ground once more, "what a cross old bird! And I didn't find out what I wanted to know, after all."

He wandered on through the woods and soon forgot about the woodpecker, because there were so many other things to see. All kinds of creatures scampered about—up and down trees and through the grass—but none of them paid any attention to the little raccoon.

"I do wish someone would talk to me," he thought, "but everyone seems to be too busy."

So he started up the tree

Just then a black beetle came running along the path where Blackface was standing. Blackface had never seen such a queer looking thing, and without thinking he reached out to touch it. Quick as a flash, the beetle fastened its pinchers in the little raccoon's paw and pinched it sharply!

"Oh! Oh! Oh!" cried Blackface, shaking his paw. "Let go! You're hurting me! *Please* let go!"

The black beetle opened his pinchers and dropped to the ground. "There! I hope that will teach you not to meddle with me another time!" he said as he scurried away.

"Oh, dear me!" Blackface thought as he licked his paw. "Everyone in the woods seems cross. But surely if I walk far enough, I'll find *someone* who will talk to me." So he kept on walking.

At last he came to an open place where bright-colored flowers bloomed in the tall grass. "Isn't this pleasant?" Blackface thought. "I'm glad I found this place."

The sun was getting low in the sky now, and the little raccoon lay down in the grass to rest. His head was sore where the woodpecker had pecked it; his paw was sore where the beetle had pinched it; and he was tired and sleepy after his long walk.

He hadn't been lying there very long when something said *buzz—buzz—buzz*, close to his ear. Blackface turned quickly. He couldn't see anything except a little creature with wings, sitting on a flower.

The bumblebee darted at his nose

"That will teach you," said the black beetle

"Was it this little fellow who made all the racket?" he wondered. Forgetting about the woodpecker and the beetle, Blackface put out his paw to touch the little creature.

Zoom! The bumblebee darted at his nose and stung it as hard as he could!

"Oh, dear me! Oh, dear me!" cried Blackface, rubbing his nose on the ground. "That hurt! Why did you do that?"

"It's the only way I have to make you stop bothering me," said the bumblebee. "Haven't you learned not to annoy others?"

"But I only wanted to find out about you," answered Blackface, unhappily.

"Well, you found out that I can sting, didn't you?" the bumblebee said. "And now I must hurry and gather all the honey I can before it is dark."

Blackface was very uncomfortable. His head was still sore where the woodpecker had pecked him. His paw was still sore where the beetle had pinched him. His nose was still sore where the bumblebee had stung him. He wanted his mother.

Blackface shut his eyes. The sky grew dark.

"Blackface! Blackface! Blackface!" he heard. Blackface jumped up. There stood his mother! "Blackface," she said, "I have been looking everywhere for you! Where in the world have you been?"

"I have been walking through the woods to see

what I could see," Blackface said, trying to be brave.

"Well, it was very wrong of you to run away when you should have been asleep in the den. Something might have happened to you."

"Something *did* happen to me," Blackface answered quickly. And then he told his mother all about the woodpecker and the beetle and the bumblebee. And when he had finished telling her, he whimpered a little and said, "I'm awfully hungry, too, mother."

His mother did not scold him any more. She only rubbed his fur with her nose and said: "You will feel better when you have something to eat. We will go down to the stream and fish for our supper. Your father and the rest of the family are already down there."

Blackface followed his mother down to the little stream. "Hello, Blackface!" called his sister Graypaws. "Come and fish with us—we're catching crawfish."

The cool water felt very good as he waded out into it. He began to feel about on the sandy bottom of the stream with the slim fingers of his forepaws. He turned over several stones before he found what he wanted, but by and by he caught a fine crawfish.

He was so hungry that he put it to his mouth at once, but his mother called sharply: "Blackface! Don't eat your food until you have washed it! I have told you that a great many times."

"But I am so hungry, mother," the little raccoon told her. "Must I wash all the food I eat tonight?"

"Yes," answered his mother. "Raccoons always wash their food when they can, so of course you must do it too."

Blackface grumbled a little, but he dabbled the crawfish about in the water for a moment or two, and then going out on the shore, he sat down and ate it greedily.

All night long the raccoon family fished and gathered berries and dug up tender roots. At last it was time for them to go back to the hollow tree.

Blackface felt very sleepy. As he trotted along through the woods behind his mother he said:

"I thought it would be fun to go out into the forest in the daytime, but it wasn't as much fun as I thought it would be."

"No," his mother answered. "The safest place for raccoons in the daytime is inside their hollow tree."

"After this, I'm going to stay in the tree in the daytime, and sleep as you and father do," he said. "But I will go out at night, won't I? I will go out every night for the rest of my life and fish in the stream for my supper."

"Not *every* night," his mother told him. "You will fish and eat all summer, but when the cold comes, you will go to sleep in the hollow tree, and you will sleep there all winter long."

"Won't I fish at all, then?" the little raccoon asked.

"No," his mother answered, "you will only sleep. Raccoons always sleep when winter comes, so you will lie safe and snug in the den. You will not wake until the warm spring is here again."

Blackface thought about this for a little while, but he soon forgot it, for winter would not be here for a long time yet.

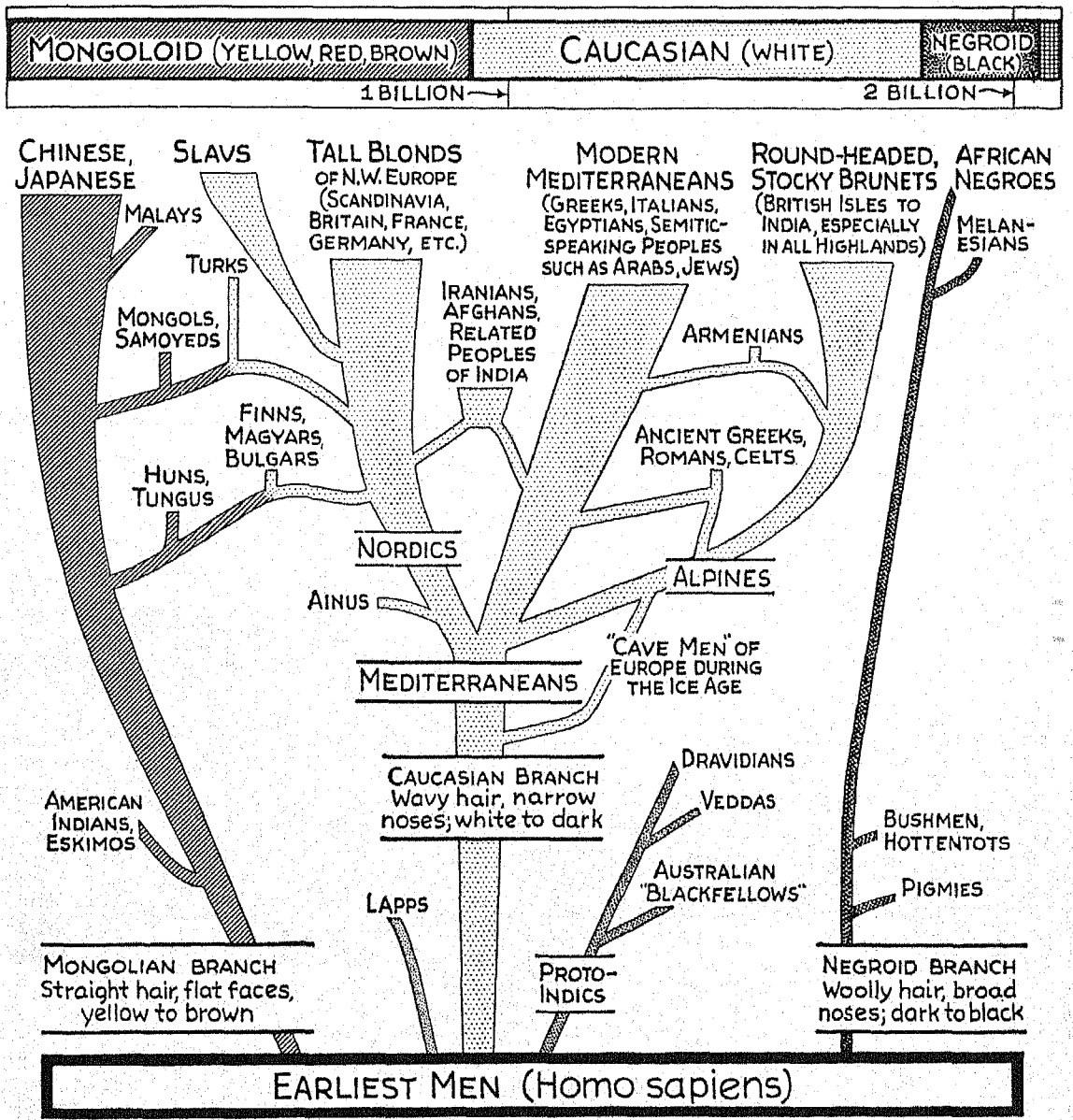
Safe up in the den once more he thought only about the fun he would have when he went fishing again.

All night long the raccoon family fished in the stream

The Many RACES *in the Brotherhood of* MAN

RACES OF MANKIND. Today, in any large seaport, the streets present a varied array of mankind—white, black, yellow, and perhaps brown. Even among men of one color, many striking differences in appearance can be noticed at a glance. Anybody can tell a tall, blond Scandinavian from a short, swarthy Greek, or a thin-faced Arab. Nobody would mistake a Spaniard for a Malay, although some might mistake the sun-blackened Malay for a Negro. The marked differences in appearance tell us that mankind has developed different strains, called "races." But to name or describe these races accurately is not easy. The chart below shows how the larger, most recognizable strains of men have been mixed together in the past; and history tells of many mixtures which are not shown. Europe has been swept, for example, by wave after wave of settlers and conquerors since the days of the Ice Age.

HOW THE CHIEF RACES ARE RELATED TO ONE ANOTHER

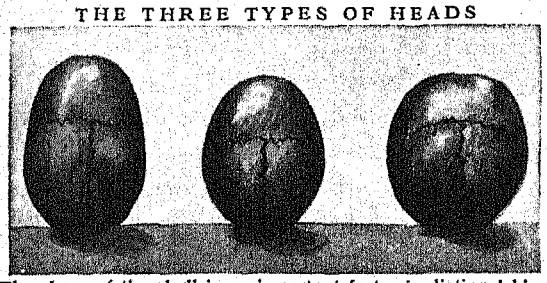


Here we see how all the races of mankind have become intertwined in prehistoric and historic times. Only such stocks as the Negroes, who have been isolated until recently, have maintained pure strains. Estimates of the relative numbers in each large stock are shown at the top. A small segment shows all peoples other than the three types which are named.

Each wave intermingled with people already on the ground and produced a mixed population within a few generations. Hence any attempt to trace any one strain or race throughout mankind is difficult.

Many plans of racial classification have been proposed, based on geographical distribution, language, physical characteristics, and habits and customs. Modern ethnology (as this branch of knowledge is called) for the most part bases its classification on physical characters alone, and considers a race as a

THE THREE TYPES OF HEADS



The shape of the skull is an important factor in distinguishing races. The three main types are shown here, from left to right, *dolichocephalic*, *mesocephalic*, and *brachycephalic*.

permanent division of mankind having a common biological inheritance as indicated by the shape of the skull, the facial angle, the color of the skin, the form and color of the hair, the shape of the facial features, the stature and proportions of the bones, etc.

The most obvious of these race-characters and the one used in the common grouping of mankind into the white, black, red, yellow, and brown races is the color of the skin. In subdividing these largest groups, however, it becomes necessary to use other physical characteristics as well. Perhaps the most important of these is the shape of the skull, especially with reference to the ratio between its breadth, viewed from above, to its length. This ratio, which is called the "cephalic index," can be roughly determined from the shape taken by a man's hat which has been worn long enough to conform to the shape of the head. Multiply the width across the inside of the hat by 100, and divide by the length, and you have approximately the "cephalic index." If the result is 75 or less, the wearer of the hat is *dolichocephalic* or "long-headed"; if it is between 75 and 83, he is *mesocephalic*, or "medium-headed"; if it is more than 83, he is *brachycephalic*, "shortheaded," or "round-headed."

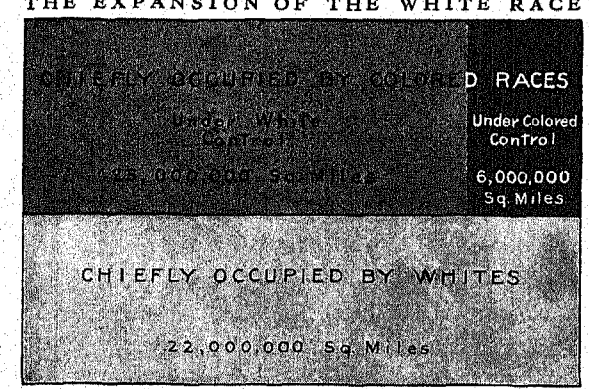
One of the most reliable tests is the type of hair. Every human being has either straight, curly, or woolly hair, and this characteristic runs almost exactly with color of skin, whether white, yellow, or black (*see* Hair). Moreover, it persists even though skin color may change, as happens when a white man is "burned coal black" in the Tropics. A newer, less-understood test which seems to run with race is the predominant type of blood in a population (*see* Blood).

On the basis of these and other physical characteristics most leading ethnologists have come to the conclusion that the white peoples of Europe are derived from three primitive races: (1) a Mediterranean race, extremely long-headed, rather short and slender, dark-haired, and of dark complexion; (2) the Nordic or Teutonic race, also long-headed, very tall, blue-eyed, and blond; (3) the Alpine, broad-headed, of short or medium stature, gray-eyed, brown-haired, and of medium dark complexion. The existing peoples of Europe, according to this view, are the result of a mixture of these three types, which are nowhere found in pure racial strains. The Scandinavian countries and northern Germany represent the greatest purity of the Nordic or Teutonic stock; the Slavic peoples and the typical stock of Switzerland and central France, that of the Alpine stock; and the inhabitants of Spain, Portugal, southern France, southern Italy, and Greece, that of the Mediterranean stock.

This and similar classifications based entirely on physical characteristics have largely superseded the older classifications based on language, which divide the peoples of Europe into three great families, the Indo-European, Semitic, and Finno-Tartaric or Turanian (*see* Philology.)

In grouping mankind as a whole, so many classifications have been proposed, varying widely according to the qualities taken as the test, that for most purposes it is convenient to retain the old classification based on geographical distribution and color of the skin. According to this scheme men fall into five main groups: (1) the Caucasian, European, or white race; (2) the Ethiopian, African, or black race; (3) the Mongolian, Asiatic, or yellow race; (4) the American (Amerind) or red race; (5) the Malay and Polynesian or brown race. Often this classification is still further simplified by including the American and Malay races in the Mongolian division.

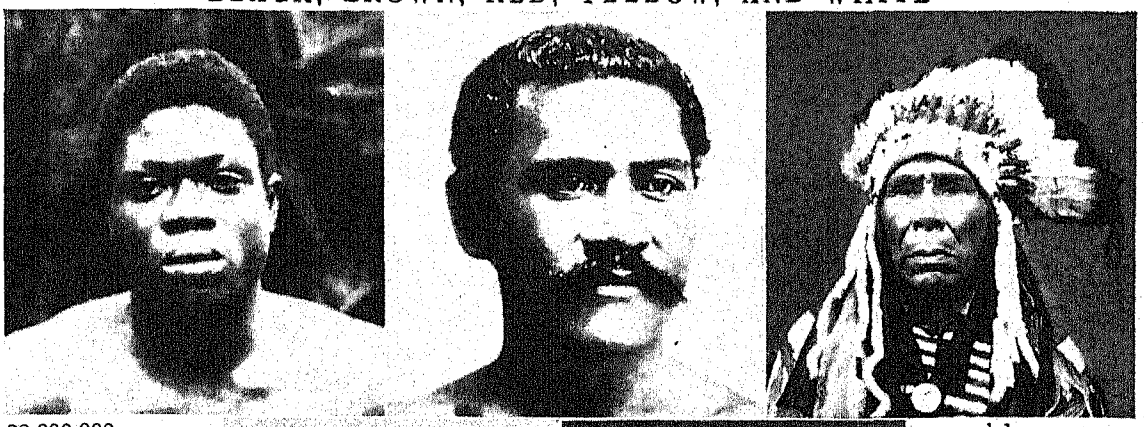
THE EXPANSION OF THE WHITE RACE



Less than one half the world is inhabited by the white race, yet the whites control nearly nine-tenths of its area.

One of the most amazing facts of history has been the world-wide expansion of the white race during the four centuries between 1500 and 1900. At the end of the 15th century the white race was confined to about 2,000,000 square miles of Europe, while the remaining 51,000,000 square miles of the earth's land area (excluding the polar regions) was possessed by the "colored" races. At the end of the 19th century, the area predominantly populated by whites was

BLACK, BROWN, RED, YELLOW, AND WHITE



Here we have an African Negro, a Malay Chief, an American Indian, a Chinaman, and a White Man, whom you recognize as Ben Franklin. These five represent the five great color divisions of mankind. In the modern classification of races, however, color does not play so important a part as formerly.

22,000,000 square miles, against 31,000,000 square miles for the colored races, while all but 6,000,000 square miles of the colored population areas were under white political control. In other words, the white races, comprising about one-third of the globe's population, held nine-tenths of its area. (*See* Population.)

How long will the white man continue to be master of the world? This is a question which political observers have been raising with increasing gravity ever since the emergence of Japan among the great world powers. There is growing unrest among the colored peoples under white domination, and there is arising a real sense of racial solidarity among the non-whites. The shock of world-wide war among the whites, first in 1914–18 and renewed in 1939, increased this feeling. Japan's successes in 1942 created belief throughout Asia and Africa that the day of white supremacy was nearing its close. The gravity of this problem is heightened by the fact that the colored races are increasing in number far more rapidly than the white.

—REFERENCE-OUTLINE *for Organized Study of* RACES OF MANKIND—

THE FOLLOWING outline gives a convenient grouping of the principal divisions of mankind, primarily according to their geographical distribution. It does not attempt to include every tribe and clan mentioned in the text or in the Fact-Index; nor does it pretend to be a strictly scientific classification, since in that matter there is no complete agreement among ethnologists themselves. For further information about any single tribe or clan *see* the Fact-Index, and *see also* the Reference-Outlines for the various continents, and for **Ancient History.**

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1. Finnish: Esthonians E-306; Finns F-44; Lapps L-64; Samoyeds (Fact-Index).
2. Ugric: Magyars H-360; Ostiaks H-360.
c. **Japanese-Korean Branch:** Japanese J-188*d*, J-188 pictures, J-193–4 pictures, M-69 picture; Koreans K-38.

B. **Southern Mongolic Family:**
a. **Tibetans:** T-89, I-34.
b. **Indo-Chinese:** I-73. Annamese I-73*b*; Burmese B-278*a*; Khmers I-73*b*; Thais (Siamese) T-73*a*.
c. **Southern Chinese:** C-212, C-78 picture.

V. **THE BROWN RACE:**

A. **Dravidian Group:** I-34. Veddahs C-137; Sinhalese C-137.
B. **East Indian Group:** E-142*b*. Malays M-42, B-197 picture; Dyaks B-196; Javanese J-205, A-327 picture; Sumatrans S-325, E-142*f* picture; Sundanese J-205.
C. **Philippine Group:** P-165. Tagalogs (Luzon); Visayas (Mindanao); Igorots P-165; Moros P-166.
D. **Madagascar Group:** Malagasies M-17.
E. **Polynesian Group:** P-4. Hawaiians H-244; Maoris N-135; Samoans S-20.
F. **Micronesian Group:** P-4.

VI. **THE RED RACE:** I-52.

A. **Prehistoric:** American Archeology A-147; Cliff Dwellers C-269; Mound Builders M-291.
B. **Arctic:** Eskimos E-300, A-104 picture, F-223 picture, G-175 picture.
C. **Northern:** Athapascan I-55; Algonquian I-52; Iroquoian I-53; Tlingit I-56; Haida I-56; Siouan I-54; Shoshonean I-54; Muskhogean I-54; Kiowa I-54; Salishan, or Flathead I-56; Pueblo I-55, N-99, P-365; Natchez, or Pawnee I-54.
D. **Central:** Aztec A-408; Maya Y-210, A-409 picture.
E. **Southern:** S-205*h*. Incas I-27, S-206*c*; Aymarás S-206*c*; Chunchos P-137 picture; Tupis, Arawaks, Caribs, Guaranis S-206; Araucanians C-207*d*; Yahgans C-207*c*, S-206; Onas S-206, S-205*f* picture; Patagonians P-86, S-206*c*.

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RACINE (*rà-sēn'*), **JEAN BAPTISTE** (1639–1699). Although he has been called the greatest dramatic poet of France, it may still be disputed whether Racine ranks higher or lower than Corneille, who first shaped French tragedy, or Molière, the great French comedian. Racine's genius at any rate was different from those others—beautiful, exquisite, poetic, and subtle.

Unlike those of Corneille, Racine's characters are well supplied with human frailties, whims, and errors. They are not great heroes, buffeting a rugged world; but they are rather twirled about in the swift current of their own passions. Thus Racine's plays are felt to be more lifelike than Corneille's; and the stories deal with what people think and feel and are, rather than with chance adventures through which they pass, no matter how nobly, or with great unnatural calamities which drop on them like bolts from the blue. Racine is also less concerned than Corneille with following set rules in writing. He observes a certain form, but he lets his own taste and the nature of his story decide for him what that form shall be. To some extent he freed French drama from the unnaturalness which comes from following rigid rules. His poetry is also more delicate, intimate, and emotional than Corneille's.

Probably much of Racine's feeling for simplicity, delicacy, charm, and sheer beauty for its own sake came from his early and wide study of Greek. He lost his parents when young, and his grandfather sent him to Beauvais College, and later to Port-Royal, a famous convent school near Paris. He spent a solitary boyhood at Port-Royal, learning "large tracts of Homer, Sophocles, and Euripides," but this period was so happy that when he lay dying he asked to be buried at Port-Royal.

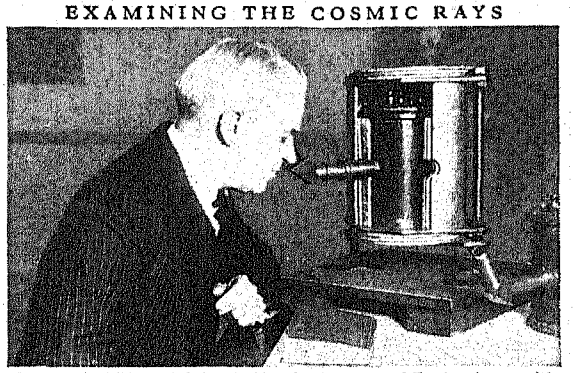
Racine's principal works are: 'Thébaide' (1664); 'Alexandre le Grand' (1665); 'Andromaque' (1667); 'Les Plaideurs' (1668); 'Bérénice' (1670); 'Bajazet' (1672); 'Mithridate' (1673); 'Iphigénie' (1674); 'Phèdre' (1677).

RADIO, LIGHT, *and* X-RAYS—*All Are* RADIATION

RADIATION. Once the only rays thought of were the visible rays of light. But now it is known that a long series of other rays exists—some of them much like light in many of their properties, others vastly different, but all called "rays" because they spread outward, or "radiate," through space.

According to theories now commonly used, these radiations fall into two classes: those of the *electromagnetic* type, consisting of "wavelike" pulses traveling through empty space, and *corpuscular* radiation, produced by streams of minute particles, electrical in nature, derived from what in ordinary speech we call "matter." In the study of them, their differences, resemblances, and natures, we come to grips with the most fundamental questions known to physical science—the question of what the universe is and how it works.

EXAMINING THE COSMIC RAYS



Dr. R. A. Millikan, of the California Institute of Technology, with one form of the apparatus by which he examines cosmic rays. The lead-shielded electroscope indicates the presence of an electric charge, while the shields serve to keep out other radiation.

Radiation as "Waves"

The distinction between the two types of radiation came into science at the start of the 19th century from discoveries made concerning light. At that time, most scientists considered that light consisted of minute particles, called corpuscles, streaming from luminous objects and creating recognizable effects when they struck human or animal eyes. But when "light interference" was discovered (*see* Light) this theory could not explain it; so science adopted a rival theory, which said that light consisted of vibrations in an invisible, weightless material pervading the universe, called the "luminiferous ether." The only trouble with this theory (as scientists then thought) was that no one could give a description of this ether sufficiently detailed so mathematical formulas "fitting" observed phenomena could be deduced from it.

Clerk-Maxwell's "Brilliant Guess"

Meanwhile, about the middle of the 19th century, the brilliant mathematician and physicist, James Clerk-Maxwell, set himself to explain the action of electricity and magnetism "at a distance"—that is, the ability of these forces to produce effects across apparently empty space—and to reduce it all to terms of mathematical formulas, so that everything known about the subject could be computed exactly from a few basic assumptions. In 1873 he published his celebrated book, 'Electricity and Magnetism'; and the theory advanced in it not only accomplished his purpose concerning these subjects, but could be made to explain how space transmitted light waves.

This theory used stresses and strains in space as the "carrier" of electric and magnetic effects. But under certain conditions such stresses and strains obviously would radiate over great distances, just as a stretched elastic wire, when plucked, carries vibrations along its length. Clerk-Maxwell thought this might explain light, since his formula for the speed of such movements, based on electric and magnetic factors, was that of light. All that was needed was to assume that the wave-lengths, or distance between pulses, were on the order of a millionth of an inch, which science already believed. If others existed, of lesser frequency and greater length, Clerk-Maxwell predicted they would produce electrical effects, if suitable detecting apparatus were devised.

Clerk-Maxwell died soon after; but his theory, sometimes called "the most brilliant guess in the history of science," was triumphantly vindicated between 1886 and 1888 when Heinrich Hertz found the predicted electric effects. From Hertz's apparatus, others developed the radio (*see* Radio); but science was interested in another result. If electromagnetic pulses of extremely short wave-length gave light, and those with wave-lengths of several yards (like Hertz's waves) or several miles (like some generated by Marconi) gave radio, what of those in between? Without going into details, it may be said that radiant heat, or "infra-red rays," were found to fill the gap; and later, in the zone of waves shorter than light, science discovered X-rays, gamma rays, and cosmic rays. Thus it had a whole array of forces—radio, radiant heat, visible light, invisible or ultra-violet light, and perhaps X-rays and the newly found gamma rays of radio, all carried through space by Clerk-Maxwell's "electromagnetic pulses," and differing only in the effects they produced and in the wave-lengths of the pulses carrying them. The array of pulses, classified by wave-length, was called the *electromagnetic spectrum*, after the spectrum of visible light, which fitted into this greater one.

The Nature of Electromagnetic Waves

Such an array, so uniform in nature, save for wave-length, suggested that all such pulses must have a common cause, differing only in details of operation. Early in the 20th century, scientists decided that their newly developed theory of matter (*see* Atoms and Electrons) had revealed this cause. It lay in the various vibrations of the protons and electrons of which all matter was supposed to be made, and different types of vibration sent out different lengths of waves —just as a great storm rolls up ocean waves as high as a ship, with their crests far apart, while a light breeze

causes ripples only an inch or two apart. The waves, however, were not supposed to be anything like water waves. A picture suggesting their supposed nature is given in the article on Light, and should be examined before reading further here. Moreover, experience suggested that, unlike water waves, electromagnetic pulses, whether of radio, light, or X-ray, should be considered to travel at the same speed, this being the speed of light, 186,270 miles a second. From this arose the fundamental relation between electromagnetic "frequency" or number of vibrations per second, and the "wave-length," which holds that "frequency multiplied by wave-length equals the speed of light," as explained in the article on Radio.

Finally, as a matter of convenience, science arranged all these pulses into octaves, according to their frequency (or what is the same thing, their wave-length) and said that waves in some of the octaves caused radio, those in other octaves caused light, and so on. The name "octave" was borrowed from music, in which a note having twice as many vibrations a second as another, is said to be the octave of the other.

At the low-frequency, or long-wave, end of this octave system stood pulses given off by electrical machinery and having a frequency of less than a hundred a second, with a corresponding wave-length of more than 45 miles. At the high-frequency, short-wave end, now stand pulses vibrating some 100 quintillion times a second, with such short waves that some 10 billion would be needed to span an inch. This gives a range of some 60 octaves of frequencies, of which visible light occupies only one octave. The accompanying table shows this arrangement.

WAVES OF THE ELECTROMAGNETIC SERIES

	WAVE-LENGTH (Metric units)	FREQUENCY (Complete waves per second)
.....	30,000 meters	10,000 ($10x10^3$)
RADIO WAVES (Practical Use)		
.....	9 meters	33,000,000 ($33x10^6$)
ELECTRIC WAVES		
.....	4 millimeters	75,000,000,000 ($75x10^9$)
INFRA-RED RAYS		
.....	800 millimicrons (millionths of 1 millimeter)	375,000,000,000,000 ($375x10^{12}$)
LIGHT		
.....	400 millimicrons	750,000,000,000,000 ($750x10^{12}$)
ULTRA-VIOLET RAYS		
.....	4 millimicrons	75,000,000,000,000,000 ($750x10^{15}$)
X-RAYS		
.....	0.1 millimicron	3,000,000,000,000,000,000 ($3x10^{18}$)
GAMMA RAYS		
.....	0.002 millimicron	150,000,000,000,000,000,000 ($150x10^{18}$)
COSMIC RAYS		
.....	0.000063 millimicron	47,600,000,000,000,000,000,000 ($47.6x10^{21}$)

The name of each group of waves is set between the figures for the upper and lower limits. While equally spaced in the table, the different zones really are extremely unequal, as examination of the figures will show. Light has by far the smallest zone, amounting to only one-sixtieth of the entire range.

Radio Waves—The Longest of All

The longest waves of which science has knowledge and which can be put to practical use are those giving us radio. Some, used in transoceanic communication, are several miles from crest to crest. The shortest in practical use are an inch or two long; but scientific experiments, using adjoining bits of metal filings immersed in oil to replace the oscillating units of orthodox "sets," have produced radio waves as short as one-tenth of a millimeter, or less than the width of a fine pencil mark. Thus the whole span of radio, or Hertzian, waves occupies some 28 octaves of the spectrum. About 11 are employed practically. The shorter waves are often called "electric waves."

Radio waves also illustrate another fundamental feature of the spectrum. They are long waves; so on the analogy of ocean waves, we should expect them to arise from tremendous electronic activity. This is the fact; for it takes great swarms of electrons, surging around specially devised circuits of the radio type, to send them hurtling through space. Less violent activity can be expected to produce shorter waves—which is indeed the case, as we shall see.

Infra-Red Rays, Which Warm the Earth

The next longest waves are those which impart heat to objects they strike. Science tells us that heat arises from increased activity of the molecules composing material objects (*see* Heat); so it would seem that waves of infra-red length, when absorbed by material objects, act by stimulating the molecules of the object to greater activity. Also we might expect such waves to arise from increased molecular activity in the objects emitting them. This is indeed the case, from the sun, which sends its heat hurtling across space to the planets in the form of infra-red rays, to a stove or radiator not even hot enough to glow.

Here again our relation between wave-length and the degree of activity required to create the wave, holds good. The longest infra-red wave overlaps the shortest radio wave. From this length, infra-red waves grade down in length to those produced by a single molecule or atom—that is, to where vibrations *within* the atom begin to produce visible light. The dividing line is at wave-lengths of about one quarter-millionth of an inch. Thus the infra-red waves occupy some nine octaves of the spectrum.

Since infra-red waves cause warmth in objects they strike, they may be detected by delicate heat registering instruments, such as thermocouples. Wave-lengths are determined by refraction and reflection, somewhat as for light, save that quartz lenses or various crystals, each able to reflect infra-red rays of a certain length,

are used. Quartz interferometers, similar in principle to those used with light, are also employed.

Next smaller than the infra-red waves are those causing visible light. They occupy only one octave of the electromagnetic spectrum, between about one quarter- and one eight-millionth of an inch, and are generated, according to modern theory, by electrons shifting in their orbits within atoms, as the article on Spectrum explains. This article also tells in detail how they are studied.

Ultra-Violet Rays and Their Uses

Next in order come the ultra-violet waves or rays, of great interest because of their effect on health, and uses in industry. Important biological properties of these rays are their sterilizing effect, or power to kill simple organisms, such as bacteria, and even human cell tissue; the ability to form pigment under the skin, resulting in tanning, freckles, and sunburn; and in their part in the creation of vitamin D by their action upon ergosterol (*see* Ultra-Violet Rays; Vitamins). Many kinds of electric lamps for producing ultra-violet rays are made, producing rays of different characteristics, for use in *phototherapy*, or *heliotherapy*, as the treatment of human ills with light is called. The common type is the electric arc; another produces the rays by means of an electric current through hot mercury vapor inside a bulb of quartz or special glass, used because ordinary glass will not allow the rays to pass. Needless to say, ultra-violet rays cannot be produced by passing light through colored glass. It is well to have the advice of a physician before using ultra-violet lamps, since improper use will do harm, rather than good.

PRODUCING A LIFE-ESSENTIAL IN FOOD

Dr. Harry Steenbock, of the University of Wisconsin, discoverer of the beneficial effect of irradiating foodstuffs with ultra-violet rays, is here shown irradiating a dish of rolled oats in the rays from an ultra-violet lamp.

Ultra-violet rays have powerful effects on many chemical reactions, and are used industrially for many purposes such as hastening the hardening of oil used on the surface of patent leather. Numerous substances will *fluoresce* (*see* Light), or shine in the dark when exposed to the invisible ultra-violet rays. Live human teeth, for example, fluoresce, whereas dead teeth will not; so that the rays may be used to advantage in dental diagnosis. Forged documents or faked works of art are examined under the ultra-violet rays, either by fluorescence or photography, or both, to obtain information as to original states, or as to attempted fraud or alterations. Both the ultra-violet rays and the X-rays affect photographic plates just as do visible light rays, so that photographs may be taken using camera lenses of quartz or some other material that, unlike ordinary glass, permits passage of the rays.

The entire ultra-violet zone extends from wave-lengths of about one eight-millionth of an inch to one-fourth of that length, where they overlap the longer X-rays. How these are generated and studied is told in the article on the subject. The shorter X-rays overlap the gamma rays given off by radioactive substances (*see* Radium and Radioactivity). The shortest of these are only about one twenty-billionth of an inch long.

"Cosmic Rays" the Shortest of All

Below these come the shortest waves of all—"cosmic rays." These rays, first detected in 1903, were studied intensely by Kohlhörster, Millikan, and others after the first World War. Their wave-length is too short to be measured by any apparatus now known. Some are powerful enough to penetrate 18 feet of lead. Many physicists believe that they originate in great atomic changes occurring in stars or in interstellar space, and that the changes may arise from the annihilation or the creation of matter.

Few concepts in science have brought more varied phenomena together, and have explained them in terms of one theory so beautifully as has this picture of the electromagnetic spectrum. Its very beauty blinded scientists to several defects. One was the sheer impossibility of conceiving a wave motion such as shown in the article on Light, moving outward in concentric spheres. Another was the failure of the Michelson-Morley experiment to detect "ether drift" (*see* Michelson, A. A.). Scientists felt, however, that sooner or later these matters would be cleared up without upsetting the theory; and it was not until the beginning of the 20th century that doubts arose, born of discoveries in other fields, particularly in corpuscular radiation.

The Nature of Corpuscular Radiation

As told in the articles on Atoms and Electrons and Radium and Radioactivity, about the beginning of the 20th century scientists came to believe in a startling new theory concerning the nature of matter. Briefly stated, this theory held that every kind of matter—which means every kind of chemical element—is composed of minute electropositive particles, called protons, and still more minute electronegative particles, called electrons. The only difference between an atom of a gaseous element like hydrogen, and one of a heavy, solid element like lead, is in the number and arrangement of these protons and electrons.

Various conditions can break one or another kind of particle loose, and they are believed to be responsible for many well-known natural effects. Electricity,

for example, is supposed to consist of streams of electrons (*see* Electricity; Electronics). These electrons have been "harnessed" to give us vacuum tubes such as we use in radio sets, and photoelectric cells (*see* Photoelectric Devices). Rearrangement of these particles within the atoms of certain substances cause some to be ejected, giving rise to the phenomenon of radioactivity. This radiation is of corpuscular type, with electropositive and electronegative rays.

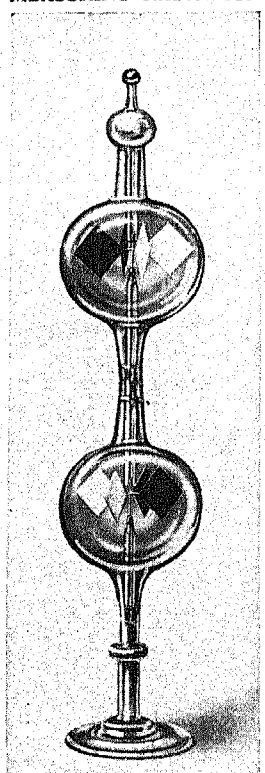
The radiation of negative electricity, or electrons, is described in the various articles mentioned. Many of the methods there described also reveal facts about the radiation of positive electricity, or protons. Study of these rays has been greatly aided in recent years by the use of the "mass spectrograph," developed by F. W. Aston (born 1877) from earlier apparatus devised by J. J. Thomson.

Aston's Mass Spectrograph

In this apparatus, positive rays ejected from the anode of a vacuum tube are passed between powerful electromagnets and electric charges, somewhat in the manner shown in principle in a picture with the article on Radium. These forces can be so balanced that the flying particles will be deflected in one direction strictly according to their mass, and the deflection is registered by their effect upon a properly placed photographic plate. Among other discoveries made with this method, Aston was able to prove the existence of isotopes among the chemical elements; for he showed that protons of the same element were deflected by different amounts, indicating that while chemically and otherwise identical they had slightly different masses (*see* Chemistry).

For a time it seemed that these discoveries could get along peaceably enough with those made concerning the electromagnetic spectrum, each covering its own field. Scientists studying corpuscular radiation, for example, had the task of explaining the atomic "electron jumps" which cause light, while students of electromagnetic phenomena had to explain the behavior of light thereafter. For a time, science expected that when each group had solved its problem, the answers would interlock. But to their consternation, this did not happen—the first real trouble coming in 1901 when Max Planck (born 1858), of Berlin University, published the results of his studies of radiant heat.

MEASURING RADIATION



The blackened sides of the vanes absorb more radiation than the white, and reaction with the gas particles makes each windmill of the "radiometer" revolve.

Planck's Constant, the Quantum, and the Photon

According to the electromagnetic theory as energy was absorbed by a radiating body, it should be given forth in gradually increasing amounts as the "intake" increased. But Planck found that the radiating body absorbed energy without giving forth anything until a certain amount had accumulated; then it gave forth a definite spurt of energy. Such a process could not be explained if energy consists of waves. But if energy consists of corpuscles, then the gains and losses will be in definite amounts which correspond to the energy charges of the corpuscles gained or lost.

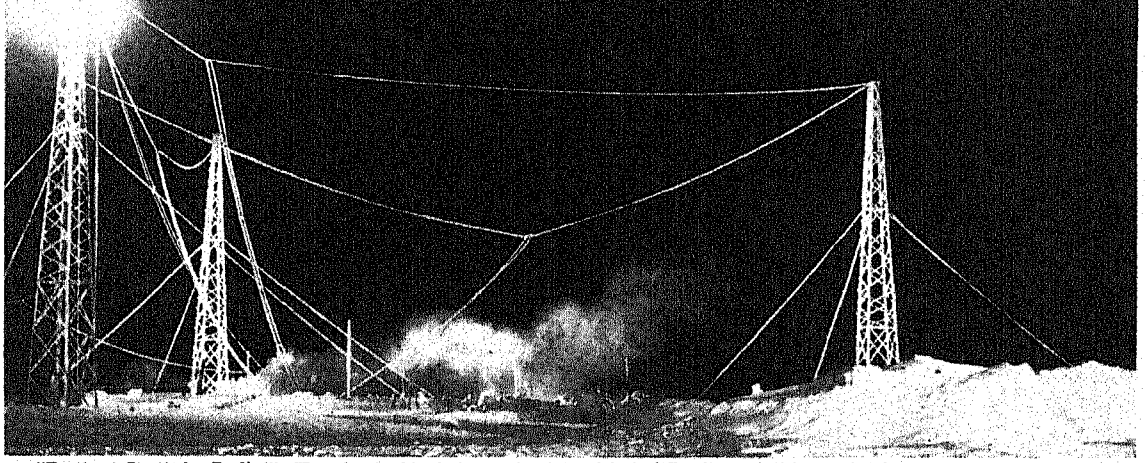
This supposed corpuscle of energy was named the *quantum*. In amount, it was found equal to the vibration rate or frequency of the radiation, multiplied by a certain number called *Planck's constant*. This could be taken to mean that energy consists of small "lumps," so to speak, of some kind. When these lumps are set to vibrating, they cause heat, light, or other radiations according to the rate of the vibration. Such a lump came to be called a *quantum of action*, to distinguish it from the pure quantum, which changes energy as its vibration rate changes.

The amount of energy in a quantum of action is inconceivably small. More than 6½ billion trillion such units are needed to make one erg, and one pound moving one foot in one second has more than 13½ million ergs of energy. Nevertheless, this tiny unit is large when compared to atoms. (In exact figures, Planck's constant is 5.66×10^{-27}.)

This theory received striking confirmation in 1913, when Bohr announced that Planck's constant was involved in the spectrum of hydrogen (*see* Spectrum and Spectroscope). Thus the quantum of action seemed to appear in light as well as in heat; and scientists renamed it the *photon* for this reason. But many thought that if light consists of photons, the wave theory of light and electromagnetic radiation must be given up. Others pointed out that the quantum or photon theory still could not explain diffraction and polarization of light, or radio.

Gradually, however, a combination of these views began to seem possible. Oddly enough, this new hypothesis rests upon a guess made by Sir Isaac Newton himself. He never was satisfied with the corpuscular theory, as many people think he was; and once he suggested that light might consist of corpuscles moving in waves. Leaders of modern physics, such as Schrödinger, Heisenberg, De Broglie, and Dirac, have produced advanced mathematical analyses of the problem which indicate that this may be true. If so, the story of radiation will be a marvelous circle, starting with Sir Isaac Newton, running through centuries of controversy, giving us our scientific knowledge of light and electricity and such boons as the radio and X-rays on the way, then coming back in the end to the Newtonian idea.

FLASHING SOUND *and* PICTURES *through* "EMPTY SPACE"—*The* MAGIC *of* RADIO COMMUNICATION.



"Farthest South for Radio!" Here in the bleak Antarctic night, Admiral Byrd's expedition maintained this radio station at its base "Little America" during 1928-29. By working with New York City, roughly two-thirds of the way around the earth, members of the expedition heard entertainment, national events, and communicated with their families and the world. Nothing could be a more striking evidence of radio's power to annihilate distance in matters of communication.

RADIO. The space about you is literally quivering with intense activity. Voices talking in English, French, German, Italian, Spanish, Japanese, and other tongues. Dispatches intended for men who live in remote polar regions or lonely Pacific islands. Programs of concerts, or lectures on their way from all the more important cities the world over. There are messages in code flashing from continent to continent, signals from ships at sea, from airplanes above the clouds. In fact, if some device could turn into sound simultaneously *all* the radio waves that are passing through your room at this very moment, you would hear the greatest jumble of noise, languages, and music that was ever caught by human ear.

The whole story of radio is the story of how these silent and invisible waves are produced in the first place, how they are detected and disentangled from one another by the instruments which receive them, and how these instruments magnify and translate them back into sounds for our ears to hear.

First, let us get rid of the common notion that radio waves consist of electricity itself passing through space like some kind of invisible lightning. Though electricity produces these waves, they are something different. They belong to the group of wave motions that includes also heat waves, light waves, ultra-violet rays, X-rays, gamma rays of radium, and so on, all of which move through space at the same rate of about 186,000 miles per second, or, to use the more serviceable figure, 300 million meters per second. (*See* Light; Radiation; Spectrum and Spectroscope.) The difference between each of these types of wave motions depends, then, not upon their speed, but upon what is called their *frequency*, that is, the number of waves that are generated per second.

Wave-Length and Frequency

Of all the known types of radiant energy, radio waves have the lowest frequencies; but even these run to such high figures, ranging up to many millions per second, that it is often more convenient to speak of them in terms of *wave-length*, which is simply the distance one wave travels before the next one starts on its way. Suppose, for example, waves are going out with a frequency of one million a second, or, to put it another way, suppose they are traveling one-millionth of a second apart. How far will a radio wave go in one millionth of a second? (Its speed, remember, is 300 million meters a second.)

Answer: 300 meters. It is called a 300-meter wave. From this we see that dividing 300 million by the frequency gives us the wave-length and, vice versa, dividing 300 million by the wave-length gives us the frequency. High frequencies mean short waves; low frequencies mean long waves.

Now let us see how radio waves are produced. The commonest type of electric current used in houses is a 60-cycle, alternating current. This means that instead of flowing continuously in one direction through the wires as does a current from a battery, the current surges first in one direction, then comes to a complete stop, then surges back in the opposite direction, making 60 back-and-forth movements or *cycles* every second. This behavior of an electric current is called *oscillation*.

Such oscillating currents produce disturbances in the space around them, generating radio waves that spread in all directions, much as a stone thrown into

a pond makes water waves, or the vibrating string of a guitar makes the air waves that we call sound. Each cycle of the current produces a wave, so that the number of cycles in the electric circuit and the frequency of the waves sent out from it are the same. Of course, a frequency of 60 waves a second, such as the house current produces, is far too low for practical radio transmission (300 million÷60=5,000,000-meter wave); but it serves to illustrate the nature of oscillating currents. Why these currents make radio waves is a question connected with the fundamental theories of physics, explained in the articles on Atoms and Electrons and Electricity. Here we need only consider how oscillating currents are produced.

"Damped" and "Continuous" Waves

When electricity leaps across a gap, like the spark from your finger after you have shuffled your feet on a carpet, or the spark from a Leyden jar, the first discharge carries an excess of electricity over, so that a part of it jumps back again immediately. But, to a lesser degree, this second discharge is again excessive, so that the back-and-forth movement continues until the electrical balance is restored. Of course, all this takes place in a very small fraction of a second, making it seem like a single flash. Fig. 1 indicates how a succession of such spark discharges behave, yielding what is called a "damped" oscillatory current, in which the oscillations are damped or diminished gradually from maximum to zero. They generate radio waves of corresponding character, and it was with spark-making apparatus that the first wireless telegraphy was accomplished, variations of short and long spark discharges being used for the dot-and-dash code signals. Because of the extreme simplicity of the method, some spark transmission is still used.

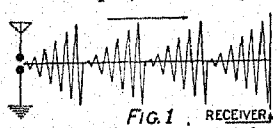


FIG. 1

Damped radio waves sent by spark set. Each set is caused by one spark, and they are shown traveling through space, instead of being on the usual "time axis." Each group actually contains thousands of oscillations.

On account of their uneven and interrupted character, however, damped radio waves are unsuited to radio telephone work or to broadcasting. A continuous, regular flow of waves is required of the form suggested by Fig. 2. It is possible to produce these undamped waves at low frequencies with alternating current generators, but their frequency range is limited by the speed at which the generators can be driven (*see* Electric Generator and Motor). The almost universal sources of radio waves today are special vacuum tubes which, under conditions to be described later, will yield oscillating currents of virtually any frequency desired.

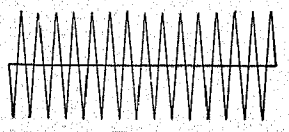


FIG 2

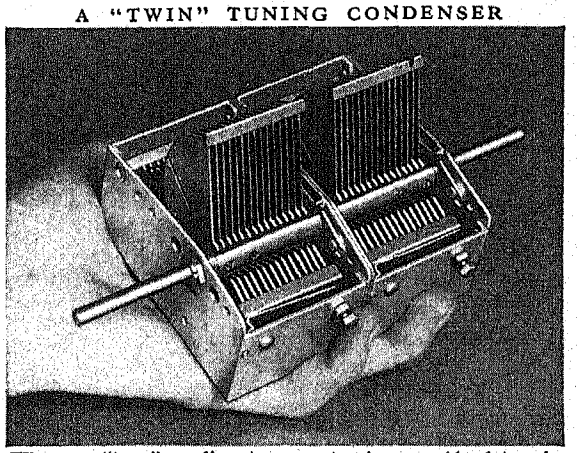
Undamped or continuous radio waves such as given by a high-frequency generator or by an oscillating vacuum tube. Upon this type of carrier wave sound fluctuations are impressed as in Fig. 3.

What controls the frequency of an oscillating current and, in turn, the frequency of the radio waves it sends out? It depends entirely upon the character of the circuit in which the current is flowing. Every electrical circuit has three properties that play an important part in radio transmission and reception. First, it has *resistance*, which corresponds to friction in a machine, and tends to reduce the energy of the current. Second, it has *inductance*, which corresponds to the inertia of mechanics, and tends to oppose *changes* in the amount and direction of current flow. Third, it has the ability to accumulate electric charges, which is called the *capacity* of the circuit, and which can be compared to the storing of energy in a coiled spring. Once again you must go to the article on Electricity for a more detailed explanation of these properties. Here we will show merely their practical application to radio circuits.

"Tuning" with Inductance and Capacity

The latter two factors—inductance and capacity—are the ones that control frequency. If we increase the inductance or the capacity, or both, in a circuit,

A "TWIN" TUNING CONDENSER



When you "tune" a radio set you are turning movable plates of a condenser like this. Maximum capacity is obtained when the movable plates are completely interleaved in the fixed ones.

we lower its frequency, and vice versa. While it is true that all parts of a circuit have a certain amount of inductance and capacity, in practical radio circuits the inductance centers chiefly in the *coils* and the capacity in the *condensers* (*see* Electricity).

The larger the number of turns of wire in a coil, the higher, in general, is its inductance. The larger or more numerous the plates of a condenser, and the closer the plates on one side are "coupled" with those on the other side of the circuit, the higher is its capacity. For ease in changing from one frequency to another, radio circuits are equipped with *variable-condensers* in which, by turning a knob, one set of plates can be moved gradually in and out of coupling with another set of plates, thus raising or lowering the capacity. These variable condensers can be seen inside any receiving set. Sometimes the coils are equipped with switches to control the inductance by including more or fewer turns of wire in the circuit.

Let us suppose that we have a circuit with its capacities and inductances so adjusted that it oscillates at a frequency of 600,000 cycles or, as it is more conveniently expressed, 600 *kilocycles*, a kilocycle being 1,000 cycles. This, as you can easily figure by the method given in a previous paragraph, will produce a 500-meter wave. How is the receiver to be adjusted to pick up that wave and none other? Simply by adjusting the capacities and inductances of the receiving circuit to correspond with those of the sending circuit. When that is done, the two circuits are said to be in *resonance* with one another, and each of them is likewise *resonant* to a 600-kilocycle current.

Explaining What "Resonance" Means

Electrical resonance becomes clear if we compare it to sound resonance. When we stretch two violin strings near each other, adjusting their length and tension so that both are tuned to the same pitch, and then pluck one of the strings, the other will start vibrating in unison with it. The energy of the sound waves from the first string is exceedingly small, yet as the waves strike the second string in quick succession and at exactly the intervals suited to its natural vibration period, they set it in vigorous motion, just as a succession of gentle pushes at just the right moment will keep a swing going higher and higher. In much the same way, radio waves, traveling over vastly greater distances and carrying only a very tiny amount of energy past any given point, still have the power to set up an oscillating current in any circuit that is resonant to them. Just as in the case of the two violin strings, the process of matching the electrical resonance of one circuit with another is called *tuning*.

Wave "Amplitude"

This brings us to another characteristic of radio waves that we have not yet considered. It is called *amplitude*. Suppose, for example, that our transmitting circuit is tuned to 600 kilocycles and we suddenly feed more power to it; what happens? Obviously the frequency will not change, for the inductance and capacity remain the same. All that the extra power does is to produce bigger waves, that is, waves of greater amplitude at the same frequency. Fig. 3 illustrates this point. It is an important point to bear in mind, since it is by variations in amplitude, as we shall see, that radio waves are made to carry sound signals in most broadcasting systems.

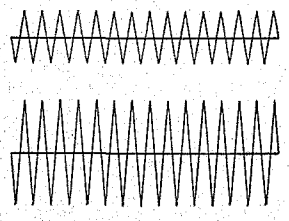


FIG 3

Both of these waves have the same frequency, but the lower one has twice as much "amplitude" or power as the upper one. Sounds, acting through a microphone, make the amplitude of radio waves fluctuate, as shown in the top part of Fig. 8.

The simplest form of transmitting circuit consists of the elements represented diagrammatically in Fig. 4. The spark coil, operated from the battery, provides the power in the form of a damped oscillating current across the spark gap; the inductance consists of a simple coil; the capacity is provided in part by a variable condenser (not shown) and in part by the capacity between antenna (aerial) and ground. When a set is grounded (connected to the earth) the antenna and the ground act as the two plates of a giant condenser, the capacity of which depends on the size and the height of the antenna. This is one reason why the selection and adjustment of the antenna plays an important part in both transmission and reception of radio.

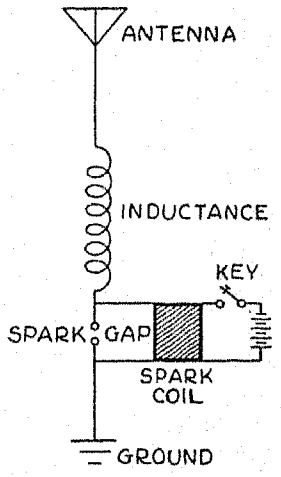


FIG 4

When the key is pushed down sparks jump the gap and continue until the key rises. A short series of sparks makes a dot, a long one makes a dash, thus enabling the operator to send code messages. The parallel lines at the right represent the battery. For simplicity, the variable condenser with which the circuit is tuned, as in Fig. 5, has been omitted.

Fig. 5 represents the simplest form of receiving circuit, using a crystal detector. Although neither spark transmission nor crystal reception are greatly used nowadays, they serve to illustrate with a minimum of confusing details the essential principles of radio practise.

We will suppose now that the sending operator wishes to transmit the letter "A," consisting of a dot and a dash. He pushes the key down for a brief instant and a short series of spark discharges leaps across the gap to make the dot. He then holds the key down

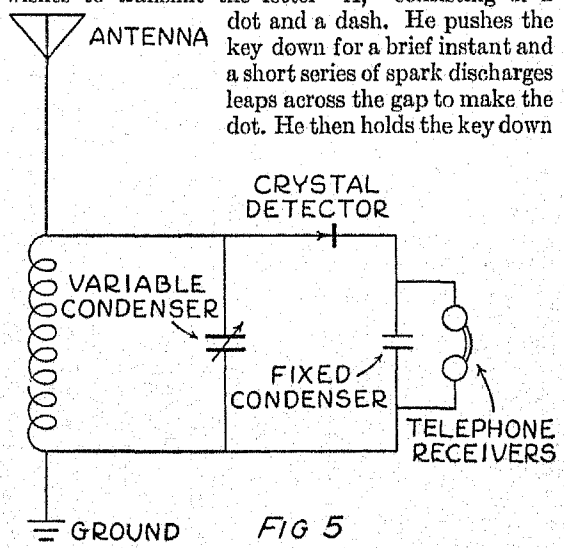


FIG 5

This represents a receiving circuit with a crystal detector. It is tuned to resonance with the incoming signal by means of the variable condenser. The crystal rectifies the signal by allowing only one-half of the oscillating current to pass through it, as explained in the text. The fixed or "by-pass" condenser permits the high frequency oscillations to escape through it to the ground, while the slower signal impulses pass through the telephone receivers where they can be heard.

a trifle longer, producing a longer series of discharges to make the dash. Out from the antenna goes a train of waves that can be graphically represented as in Fig. 6. Here as well as in Figs. 1 and 7, the waves are shown traveling through space, the first emitted being farthest from the sender. The usual diagram, however, shows the first at the left, the arrangement being according to *time* of emission.

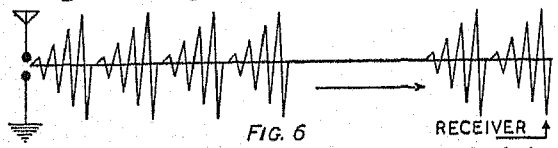


FIG. 6

These waves carry the letter "A" in code—a dot and a dash.

These waves reach the receiving antenna and there set up an oscillating current of exactly the same form. How is this signal to be heard in the telephone receiver? As you know, if you have examined such a receiver or read the Telephone article, it consists of a magnet with small coils of wire around its poles. Fluctuations of current through these coils (provided they are not too rapid) affect the pull of the magnet on the diaphragm of the receiver, making it vibrate in tune with the current. But, of course, neither the magnet nor the diaphragm can act fast enough to record the separate oscillations of a high-frequency radio current, and even if they could, the vibrations would be far above the range of human hearing (*see* Sound). However, the oscillations are divided into groups, corresponding to the number of spark discharges that jumped the gap of the transmitter, and their rate (from a few hundred to a thousand a second) is well within the range in which the diaphragm and our ears can respond to vibrations.

"Rectifying" and "Detecting"

Even so, we cannot get results by feeding this series of impulses directly into the telephone receiver, because half of each impulse consists of current moving in one direction and half of current moving in the opposite direction. This would neutralize the effect on the magnet and the diaphragm would not vibrate at all. So we introduce into the circuit a type of crystal which has the peculiar property of allowing electric current to pass only in one direction. There are several such crystals, those of silicon, galena, and carborundum being among the most common. The result is to suppress half of the current, producing an effect that we illustrate in Fig. 7.

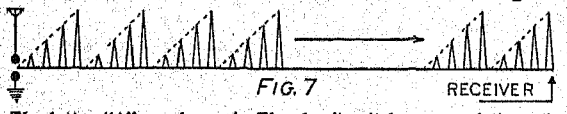


FIG. 7

The letter "A" as shown in Fig. 6, after it has passed through the crystal detector. Only half of the signal is left.

The current that gets through now consists of a series of one-direction impulses that can actuate the magnet of the receiver and register on the diaphragm with a buzzing noise—a short buzz for the dot and a longer buzz for the dash. The crystal in this case is called a *rectifier* or a *detector*. Presently we shall see how a vacuum tube can be made to act as a detector. But first let us consider how the transmission of sound compares with the spark transmission method just described.

Carrier Waves and Modulation

As we noted earlier, a current of continuous undamped oscillations is required (*see* Fig. 2). We will suppose we have a circuit producing such a current. Into this circuit we introduce a microphone, which is nothing more than an extremely sensitive telephone transmitter. As long as no sound goes into the microphone, the circuit sends out high-frequency waves that are all of the same energy or amplitude, and therefore inaudible in a receiver. They are called *carrier waves.* But as soon as we talk or play music into the microphone, its diaphragm vibrates in exact response to the sounds, and its vibrations affect, just as they do in a telephone line, the quantity of current that flows in the circuit. If the tones we make are faint, the vibrations are small and produce only small increases or decreases in the current; loud tones produce large changes; high-pitched notes yield rapid current fluctuations, while with low notes the fluctuations are slow.

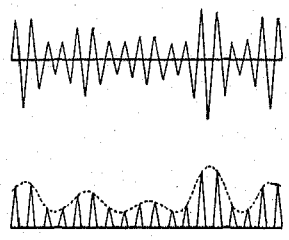


FIG 8

Above is a continuous carrier wave, as shown in Fig. 2, after sound variations have been impressed upon it. Below is the same signal after it has been rectified as the text explains. The dotted line represents the sounds created in the telephone receivers or the loudspeaker by the varying rectified current.

Exactly as the current in the microphone circuit varies in response to the sound, so does the amplitude of the carrier waves, as indicated in the upper diagram of Fig. 8. This method of impressing *audio-frequency* waves upon *radio-frequency* waves is called *modulation.* When the current set up in the receiving circuit has been rectified, we get the result shown in the lower diagram. The wavy line represents the variations of direct current energy that will reproduce the sounds in earphones or loudspeaker.

So far we have examined the essential principles involved in sending and receiving radio waves. These principles apply as well to the most powerful sending and receiving methods in use today as they did to the first spark-and-crystal methods of radio's infancy. However, the practical application of radio would probably still be in the infant stage had not the radio vacuum tube been invented. This amazing device bears many names—audion, triode tube, thermionic valve, etc.—but the common practise in America is to call it simply the *radio tube.*

The quickest way to grasp the construction and behavior of a vacuum tube is to see how it works in a simple one-tube receiving circuit such as is represented graphically in Fig. 9.

The filament of the tube is heated by the current from the "A" battery in the same way as a flashlight lamp is set glowing by its battery. Such heated metallic filaments (in this case often made of tungsten impregnated with thorium) give off streams of electrons (*see* Atoms and Electrons; Electronics). These electrons, carrying, as they do, *negative* charges of electricity, are strongly attracted by the *positive* charge produced on the plate of the tube by the "B" battery. The higher the voltage of the "B" battery, other things being equal, or the hotter the filament, the more electrons will flow. This stream of electrons acts as a conductor between filament and plate, much as if it were a wire bridging the space, and this completes what is called the plate circuit.

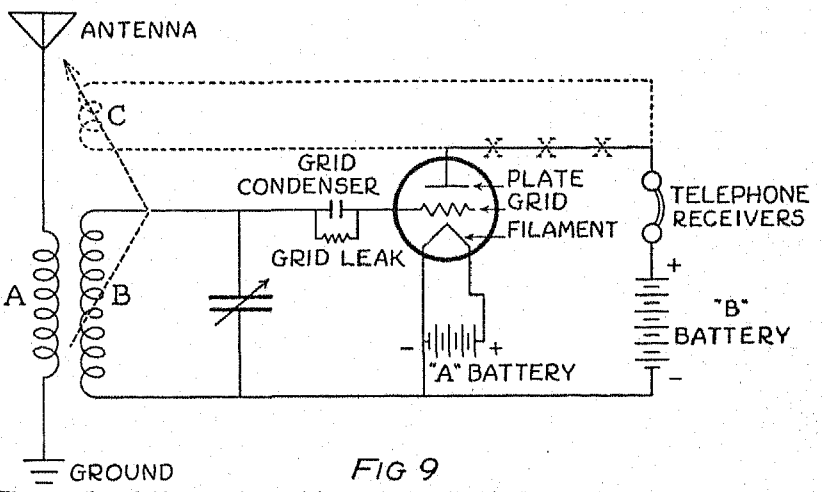


FIG 9

The operation of this one-tube receiving set is described in the text. Heating the filament sets up current in the plate circuit, running from the "B" battery, through the filament, plate, the wire marked with X's, and the telephone receivers. Incoming signals pass through the antenna circuit, consisting of the antenna, coil B and the ground, and are impressed as the text explains, upon the current in the plate circuit, by means of induction between coils A and B, and the grid circuit, consisting in part of the grid condenser and grid leak. The counterpart of each charge passing this way is considered as passing through the "minus" wire of the "A" battery leading to the filament. All these connections taken together form the "grid circuit," which is really a "charge circuit," incapable of carrying current from either battery because of its condensers. The antenna circuit is tuned by the variable condenser D. The text explains the function of the grid leak and grid condenser, and how a tickler coil C may be used. When C is used, the wire marked with X's is omitted. In an actual set C is mounted within the inductive field of B, as indicated by the dotted arrow. The text tells how this circuit can be made regenerative or oscillatory.

The Vacuum Tube as an Amplifier

The current flowing through this circuit while the filament is lighted remains constant so long as the grid of the tube is electrically neutral. But now we will suppose that a train of modulated radio waves passes this receiving set, which has been tuned to resonance with them. At once a corresponding oscillating current is set up in the grid circuit shown in Fig. 9, and every fluctuation of this current produces corresponding changes in the electrical charges on the grid. These are called changes in "potential," that is, in the positive or negative relation of the grid to the filament or the plate.

Since the grid stands between the filament and the plate, it is evident that when this charge tends toward the positive side it will reinforce the positive attraction of the plate, increasing the flow of electrons from the filament to the plate and, therefore, also the flow of current in the plate circuit. When the grid tends to be negative, it will oppose the flow of electrons because charges of like sign repel each other and, therefore, decrease the current flow.

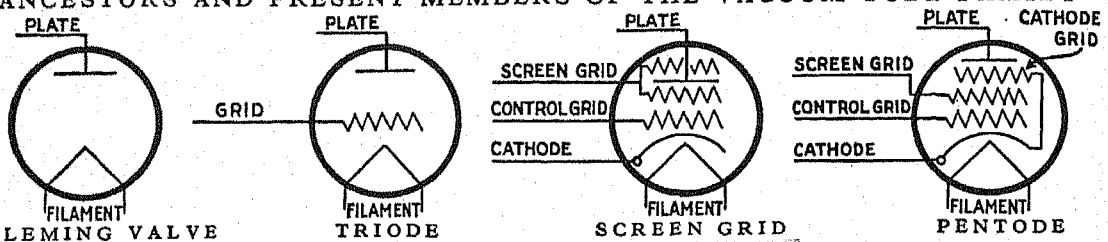
The important part of the whole process is this: Every little fluctuation in the *very weak* current oscillating in the grid circuit controls the relatively powerful direct current flowing in the plate circuit. Thus is accomplished what is called *amplification.* What was formerly a feeble signal becomes powerful.

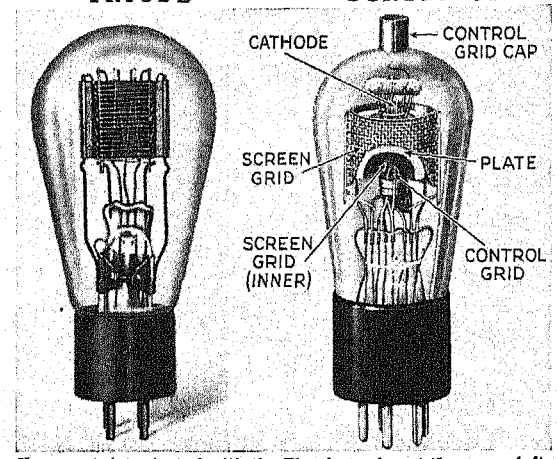
It is obvious that this same process can be repeated by passing the once-amplified current from the first tube on to a second tube where it will be amplified again. This transfer is usually accomplished by "inductive coupling" (*see* Electricity) between a coil in the plate circuit of the first tube and a coil in the grid circuit of the second tube. This process of magnifying the incoming signal before it is detected is called *radio-frequency amplification.* It is seldom carried out through more than four successive tubes or "stages." (When coils from separate circuits adjoin each other end to end or side by side, a fluctuating current in the first coil will set up a similar current in the second coil by electromagnetic induction. Such an arrangement of coils is what is meant by "inductive coupling" or induction.)

The Vacuum Tube as a Rectifier and Detector

This ability to amplify makes vacuum tubes valuable not only in radio, but in many other fields, such as long-distance telephony, where relays of vacuum tubes keep the current sustained so that speech is possible even over such distances as that between San Francisco and Paris. A second important property of vacuum tubes is their ability to *rectify* alternating currents—that is, to take an input of alternating current on the grid, and furnish a direct current to the plate circuit. This is accomplished by giving the grid a "negative bias," or negative charge. This can be done either by connecting the negative terminal of a small "C" battery to the grid, or by using a suitable condenser and high resistance (called the grid condenser and grid leak), which insure that negative electrons once on the grid can only leave slowly. The bias is so arranged that the negative grid charge is always greater than any positive charge which may be brought in upon the grid.

ANCESTORS AND PRESENT MEMBERS OF THE VACUUM TUBE FAMILY





Vacuum tubes started with the Fleming valve at the upper left. The text explains how Lee De Forest added the grid, creating the triode or audion. A modern triode is shown immediately above at the left, with part of the plate broken away to show how the fencelike grid surrounds the M-shaped filament. Addition of a cathode gives the "screen grid," and of another grid, the "pentode." In these two tubes, the filament is simply a heater, and the cathode gives off the necessary electrodes. A screen grid tube is shown immediately above at the right.

Now picture what happens when an alternating current having first positive, then negative, potential, is impressed upon this negative charge. The positive charges diminish the negative grid charge, while the negative ones reinforce it. Thus the grid charge is alternately weakly negative, and strongly negative. These fluctuations are reflected in the plate circuit by greater or less strength in the direct current always flowing in that circuit. We say, therefore, that the alternating current has been rectified, although this is not strictly true, in the sense that a crystal rectifies an alternating current. What has happened is that an incoming alternating current has been used to produce variations in the strength of a direct current, corresponding exactly to the alternations of the first current. It is by this action that a tube "detects" incoming signals and tubes which perform this function in a set are called "detectors."

The Vacuum Tube as an Oscillator

The third way in which a vacuum tube can be used is as an *oscillator*. Let us imagine a tube connected with grid and plate circuits so balanced that the two are in virtually perfect resonance or tune with each other. A phenomenon called "feed-back" will take place, where the stronger plate circuit oscillations are picked up by the original grid circuit, greatly reinforcing the feeble oscillations already going on there. This, in turn, tends to pass more energy on the plate circuit, which again feeds back more powerfully to the grid, and so on, until each strengthens the other to the maximum point. Sometimes this feed-back takes place through the capacity existing between plate and grid, which acts like a tiny condenser inside the tube. Sometimes it is brought about more powerfully by a special "tickler" coil coupled by induction to the grid circuit coil, as indicated by the dotted lines in Fig. 9. This produces a circuit of the *regenerative* type, which is very sensitive and efficient.

When, however, this feed-back is carried too far, the tube goes into "self-oscillation," usually marked in a receiving set by howls and squeals. The oscillations are transmitted back to the antenna, where they proceed to send out their own independent train of radio waves, so that the set becomes a miniature broadcasting station, much to the annoyance of neighboring radio listeners, who hear those same howls and squeals in their own sets.

Undesirable as this self-oscillation may be in a receiver, it is the very principle employed by transmitting stations for generating carrier waves except that high-power tubes and heavy currents are used, with elaborate controls for insuring exact results.

The Superheterodyne Circuit

A small self-oscillating circuit is deliberately employed as a part of the *superheterodyne* system used in the majority of receivers today. This system is based on the fact that it is possible to mix two oscillating currents of different frequencies to produce a "beat" current whose frequency is equal to the difference between the two (*see* definition of beats under Sound). This is known as "heterodyning." We will suppose, for example, that the incoming signal has a frequency of 600 kilocycles. If the oscillator in the set is tuned to 400 kilocycles, the frequency of the resultant signal (otherwise unaltered) will be 200 kilocycles. This signal can then be fed into an *intermediate-frequency amplifier* permanently tuned at 200. Whatever the frequency of the incoming signal may be, the oscillator can be tuned with it to yield a 200-kilocycle beat, to which the rest of the set is resonant. One of the great advantages in this method is that amplification at moderate frequencies is much easier and more effective than at high frequencies.

"Audio-Frequency" and "Choking"

After a radio signal has passed through the detector tube, whether it underwent radio-frequency ampli-

fication before that or not, it still lacks the power to operate a loudspeaker. It must be amplified still further in its rectified state. For this purpose one or more stages of *audio-frequency amplification* are used, consisting of step-up transformers (*see* Transformer) and additional amplifying tubes. The point which distinguishes audio-frequency amplification from the radio-frequency type is the use of "choking" in the audio transformers. As the article on Electricity explains, the more inductance a coil has, the more slowly current is built up in it, and inductance can be increased in a transformer by adding more coils of wire or using an iron core. For audio-frequency amplification, a transformer is given so much inductance that by the time the rapidly changing potential of a radio-frequency current gets a current change started through the coil one way, the potential has changed in sign, and ceases to build up the newly started amplified current. Thus the amplified current "dies," so to speak, before it gets well started—or, in the customary term, it has been choked by the high inductance of the coil. The energy represented by these choked frequencies is dissipated through "by-pass" condensers, and only the audio-frequency fluctuations corresponding in frequency to sounds get through the coil. These are increased in amplitude, by both the rise in voltage due to the transformers and the use of more powerful currents in the plate circuits of the audio tubes, until they are strong enough to set up mechanical vibrations in the loudspeaker which reproduce the sounds.

So much for the essentials of transmission and reception. The following is a brief summary of the principal parts of radio circuits, showing how they may vary in form and use:

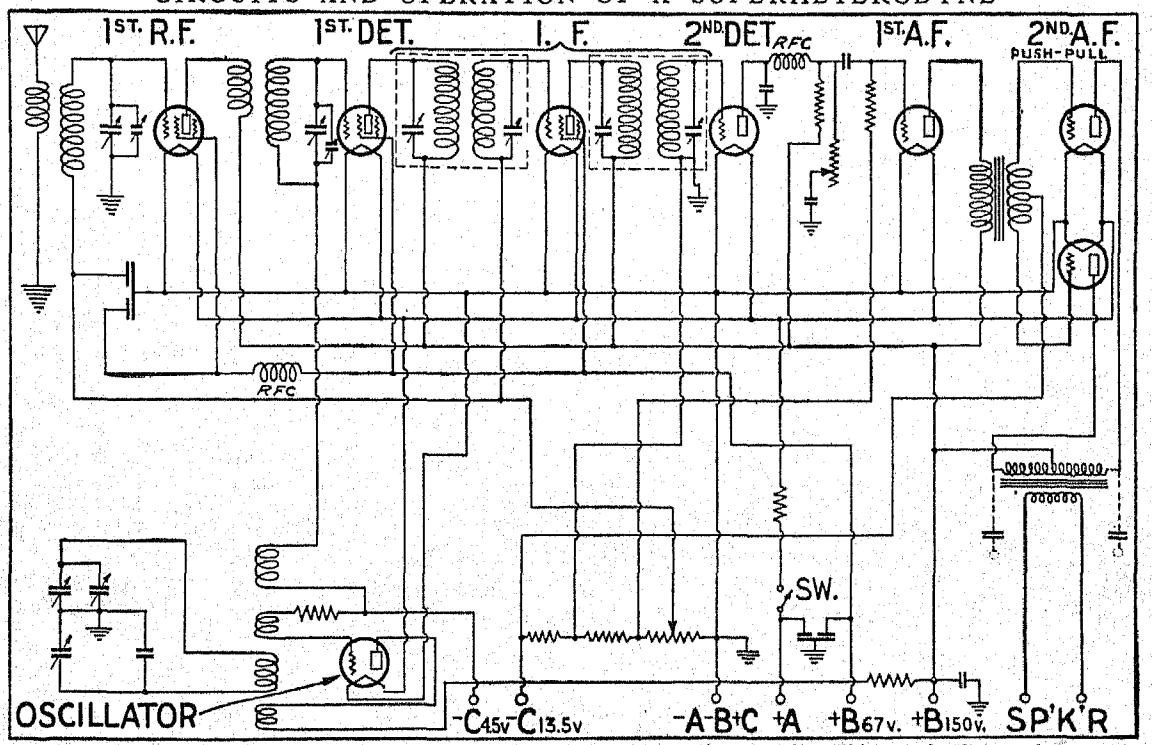
Antenna: Consists usually of several parallel wires for broadcast and long-wave transmission, and of a single wire for short-wave transmission and for reception. A "loop" antenna, consisting of one or more turns of wire around a frame, can be used for reception. It has strong "directional" properties, producing a maximum signal when the edge of the loop is turned toward the transmitting station, but little or no signal when the loop faces the incoming waves. Direction finders and radio compasses on ships and aircraft usually employ this principle (*see* Navigation).

Coils: Their size and number of turns help to determine the tuning of a circuit. They are also used in pairs as air-core transformers to transmit the radio-frequency current by induction from one stage of the circuit to the next.

Condensers: Fixed condensers are used chiefly where it is necessary to pass an oscillating current but to block off the direct plate or filament current. Variable condensers are used for tuning, in conjunction with coils.

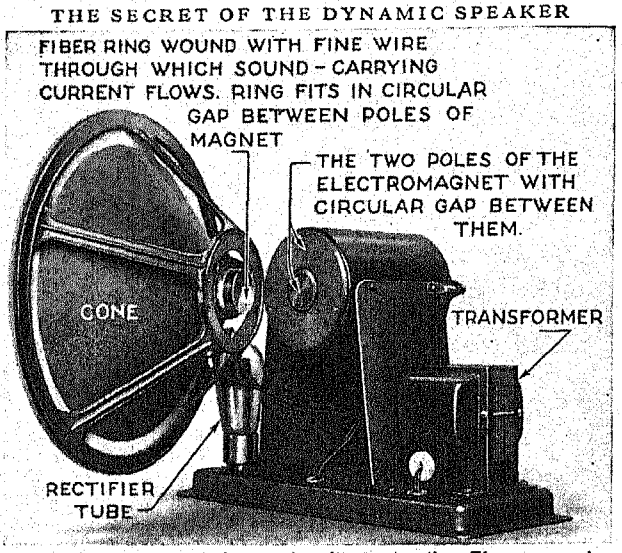
Vacuum Tubes: Besides the simple type described earlier, there is the "screen-grid" tube containing an extra grid which helps to prevent feed-back and so permits greater amplification without the danger of oscillation; the "pentode" tube with a third grid to help eliminate the crowding

CIRCUITS AND OPERATION OF A SUPERHETERODYNE



Here is a circuit diagram of a simple superheterodyne receiver, designed to use the new "air-cell" battery for filament heating. As explained in the text, the oscillator sets up oscillations which beat against those existing in the grid circuit of the first detector, or modulator. The output of this tube passes to the intermediate-frequency amplifier, is rectified by the second detector, and goes through resistance coupling to the first audio-frequency amplifier. The final stage is the so-called "push-pull" method. The speaker leads shown are for the voice coil of a dynamic speaker; if a magnetic type is used, it must be connected to the posts shown by dotted lines. These lead to the output transformer, which thus becomes a choke.

THE SECRET OF THE DYNAMIC SPEAKER



A dynamic speaker opened up to show its construction. The cone carries a ring wound with fine wire—the "voice coil"—which normally rests in a strong magnetic field in the circular gap between the poles of the electromagnet. When a fluctuating current passes in the voice coil, the coil vibrates to produce sound waves.

of electrons around the plate; and the "A.C." tube, the filament of which can be heated with alternating current. All of these are made in a wide variety of sizes.

Audio Transformers: Both the primary and secondary windings of an audio transformer consist of many turns of fine wire around an iron core, used in increasing inductance.

Batteries: Before the advent of receivers that are run by the house current, all sets used batteries. The "A" battery, usually of 6 volts, lights the filaments of the tubes; the "B" battery, ranging up to 180 volts or more, provides the plate currents; and the small "C" battery is used to regulate the negative bias of the grids of the tubes.

Loudspeakers: The early type of loudspeaker was nothing more than a large telephone-type receiver attached to the base of a megaphone horn. Later the horn was discarded, and the magnet, instead of acting on a diaphragm, worked on an armature mounted between its poles. The armature, in turn, transmitted its vibrations through a pin fastened to the center of a large cone. This is the principle of the so-called "magnetic speaker." The "dynamic" type of speaker contains a powerful electromagnet energized by an independent current. The current carrying the signals passes through a coil fastened to the cone. This coil is more or less strongly attracted by the electromagnet, depending upon the fluctuations of the signal current it carries, and so transmits its vibrations to the cone.

Shielding: In most modern receiving sets the various stages are separated from one another by metal shields to prevent undesired "coupling" or interaction between them. The shields may consist of individual containers for each tube or coil. The whole set may be protected by a metal case or by a metal lining in the wooden case so that it will not pick up so many stray signals or static from near-by house wiring, sparking motor commutators, or other sources.

How far will radio messages carry? Signals have been known to encircle the earth and come right back to the starting place. Observers are sure that they do this, because the returning waves are received at intervals of about one-seventh of a second after transmission, which is the time required for the distance traveled. Many people have wondered, "How do radio waves go around the earth if they travel in straight lines?" The explanation is that the waves proceed by a series of zigzag reflections between the ground and the *ionosphere*, a zone of ionized gas extending from 35 to 200 miles up in the atmosphere. The lower part of this zone is known as the Kennelly-Heaviside layer, after the two men who first suggested that it reflected radio waves.

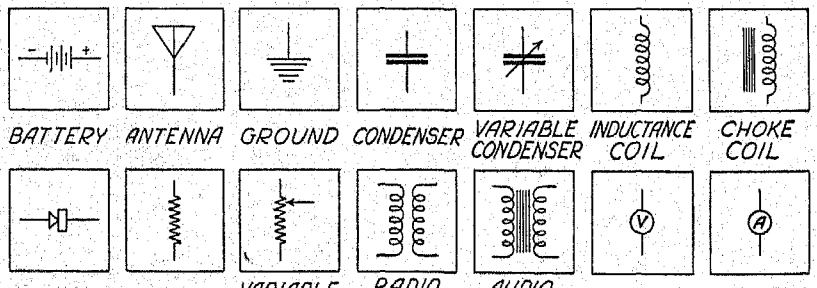
Short Waves and Radio Beams

This reflection of waves makes long-distance *beam transmission* possible. As explained later, a special arrangement of antenna wires is used to concentrate the outgoing waves into a narrow cone. This cone is aimed in the desired direction and perhaps 15 degrees above horizontal. It strikes the reflecting layer several hundred miles away, and then it zigzags between earth and sky until it reaches the receiving station. Short waves are used for such work because they can be concentrated easily into a cone and because they can be reflected more accurately and with less cumbersome equipment. Messages can be sent on beams with as little as a hundredth of the energy that would be needed to reach the same distance by broadcasting in all directions; and short-wave messages can be sent all around the earth.

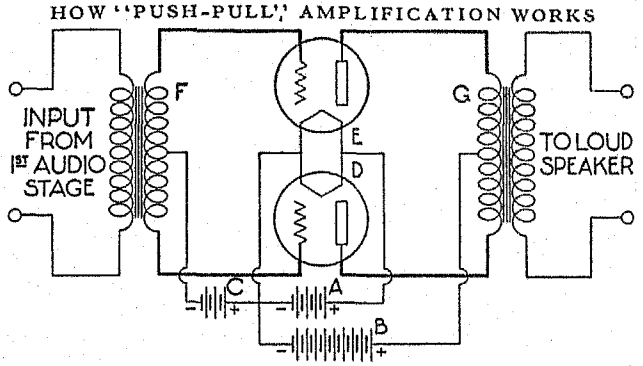
Radar and Other Short-Wave Devices

The beam method of short-wave radio transmission has been applied in many other ways. One of these, the *radar* system, was developed during the second World War to detect planes, ships, or other objects through darkness or fog. When a short-wave beam strikes an approaching plane, for example, a part of the beam is reflected back toward the sending apparatus. From this "echo" the radar instruments are able

THE "ALPHABET" OF RADIO PROGRAMS



The principal symbols used for the various parts of a radio circuit are shown here. The two upper right-hand symbols can also represent, respectively, a radio-frequency choke RFC and an audio-frequency choke AFC.



In "push-pull" audio amplification, the batteries A, B, and C operate two tubes D and E, giving the grids equal "negative bias," and the plates equal current, through the center taps on the transformers. Input from the first audio stage, by induction in transformer F, places equal and *opposite* charges on the two grids. If the charge on the upper grid is positive, this in effect "pushes" more electrons into the upper end of the transformer G. Meanwhile the negative charge on the lower grid in effect is "pulling" electrons from the lower end of G. The combined "push and pull" enable the secondary of G to furnish more power to the loudspeaker than it otherwise could. Of course, every time the grid charges reverse, so do the "push and pull."

to determine with great accuracy both the direction and the distance of the plane in question.

Similarly, aviators equipped with radio-sounding apparatus can determine how high they are flying above the ground, even when the earth is invisible. Because the degree of reflection varies with different substances, prospectors are able with radio beams to locate deeply buried ore and oil deposits. High-frequency circuits of the kind that generate short waves are extremely sensitive to changes in their surroundings. Unless carefully shielded they react, for example, to the approach of a human body or of a piece of metal. This fact has been applied to burglar alarms and to devices for locating land mines in wartime.

Short-wave radio also permits the remote control of ships and airplanes which carry neither pilot nor crew. Receiving circuits, each sensitive to a certain definite signal, are installed. These operate electrical relays which, in turn, switch on motors that regulate the craft's engine, steering mechanism, and so on.

High-Frequency Heating Effects

The oscillating electrical field between the terminals of a powerful high-frequency circuit may exert sufficient force to set into violent motion the molecules of any object introduced into that field. The result is a sharp rise in the temperature of the object, particularly those parts of it that offer a high resistance to electrical flow. The *diathermy* machines used in medical heat treatments work on this principle. It has been applied also to baking the plastics that unite layers of plywood and to melting extremely thin layers of tin to coat tin plate smoothly and evenly.

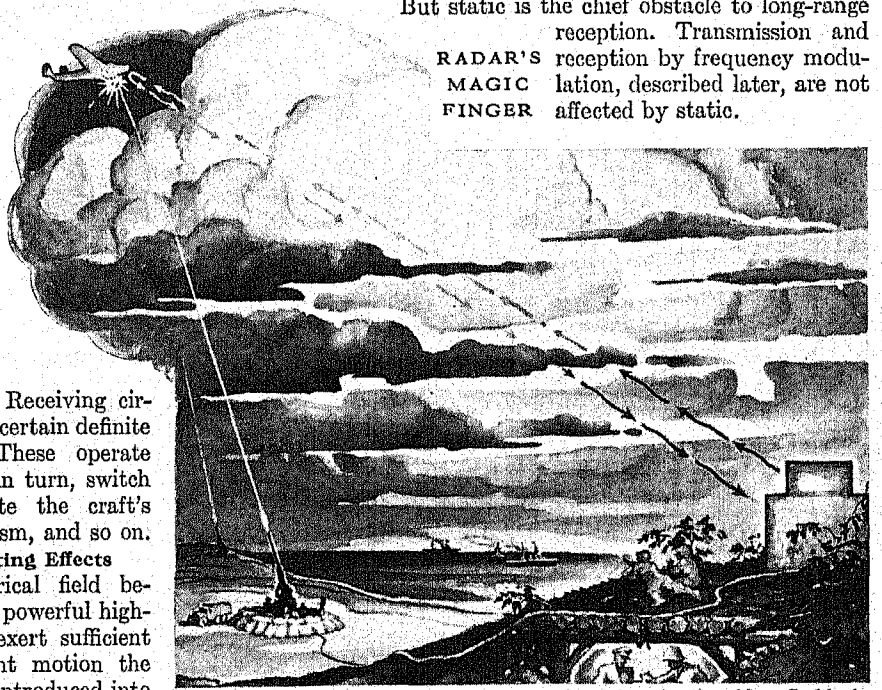
Hand in hand with the researches of scientists has gone the work of the amateur owners of short-wave transmitting stations who have been responsible for numerous practical developments in radio. These amateurs, many of them only boys, are joined in an international league (American Radio Relay League) and are constantly in communication with one another. They hold several records for long-distance signaling, and are often the first to receive news from remote places.

"Fading" and "Static"

The chief obstacles to good radio reception are *fading*, *static*, and *interference*. Often in the midst of a message or broadcast coming from a distance, the sound will fade out for a time and then return. Radio theory blames this on changes that take place in the reflecting layer of the ionosphere.

The crackling noise called static is caused by electrical disturbances in the atmosphere, by the sparking of electric motors, or the operation of near-by X-ray apparatus and similar devices. Local broadcast signals are usually powerful enough to be heard with receivers turned down below the static level. But static is the chief obstacle to long-range reception. Transmission and reception by frequency modulation, described later, are not affected by static.

RADAR'S MAGIC FINGER



Short-wave beams from the instrument at the right scan the skies. Suddenly from an enemy plane above the clouds come reflected waves like an echo. At once the radar records its direction and distance, and through automatic electric controls directs the fire of the guns on the unseen target.

Interference between stations is diminished or eliminated by assigning to each station a definite wave-length sufficiently removed from that of stations using almost the same wave-length in the same territory, to prevent receivers with good selectivity from picking them both up at once.

The Piezo-Electric Quartz Crystal

Since all available radio channels are much overcrowded, if any broadcasting station strays from the exact frequency assigned to it, there is sure to be a heterodyne effect which makes itself audible in the receiver as a continuous squeal when one or the other of the interfering stations is tuned in. The better stations prevent such trouble by using the piezo-electric quartz crystal. The word *piezo*, derived from the Greek, means pressure; if a piece of quartz, ground with flat, parallel sides, is placed in a circuit, the voltage applied to it will set up oscillations which maintain a steady rate depending mainly upon the thickness of the quartz, its temperature, and the pressure applied to it. Oscillations of other frequencies are blocked, and only the correct frequency is emitted by the station.

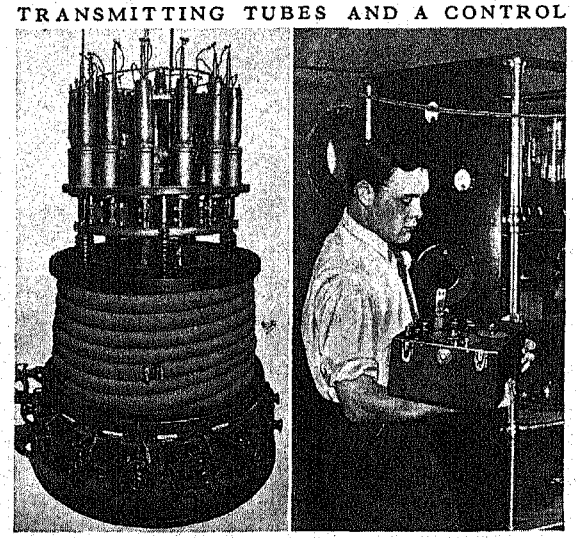
Station Licensing

No radio transmitting is permitted in the United States except by stations and persons who hold licenses from the Federal Communications Commission. The license fixes the frequency, power, and the call letters which designate the station. In assigning frequencies, the Commission observes the allocations provided in the International Telecommunication Convention (Madrid, 1932), as modified by the North American Regional Broadcasting Agreement (Havana, 1937). The 1937 allocations went into force at midnight, March 29–30, 1941. Bands are reserved throughout the range of frequencies for governments, aviation, ship communication, the police, and for international broadcasting. Commercial broadcasting uses frequencies between 550 and 1,600 kilocycles and between 25,025 and 26,975 kilocycles. Amateurs use frequencies from 1,716 to 2,000; 3,500 to 4,000; 7,000 to 7,300; 14,005 to 14,395; and from 28,000 to 30,000.

The call signals of stations are also assigned by international agreement. Each nation is assigned letters or groups of letters for its exclusive use.

The first or first and second letters of a station's call signal must be the same as those assigned to that nation, to show the station's nationality. Thus the United States uses N for its naval stations, and K and W for regular broadcasting stations. Great Britain's national letters are G and M; Russia's, R and U. Countries which have relatively few stations do not need the many combinations that can be worked out from exclusive use of a letter. Hence these countries are assigned groups of three-letter combinations starting with the same first letter. Thus Spain is given the range EAA–EHZ, and Ireland has EIA–EJZ. If the number of stations increases enough to warrant more combinations, additional ranges are assigned; thus Germany, which had only D, was later also given EZA–EZZ.

TRANSMITTING TUBES AND A CONTROL



At the left is a bank of 15 huge water-cooled vacuums used in transatlantic telephony. The long hose carries double distilled water for cooling the jacketed tubes. The principles, however, are the same as those given in the text for ordinary "oscillating tubes." At the right, a station operator is holding a "wavemeter," with which he periodically tests the wave-length of the outgoing "carrier" to make sure it is correct.

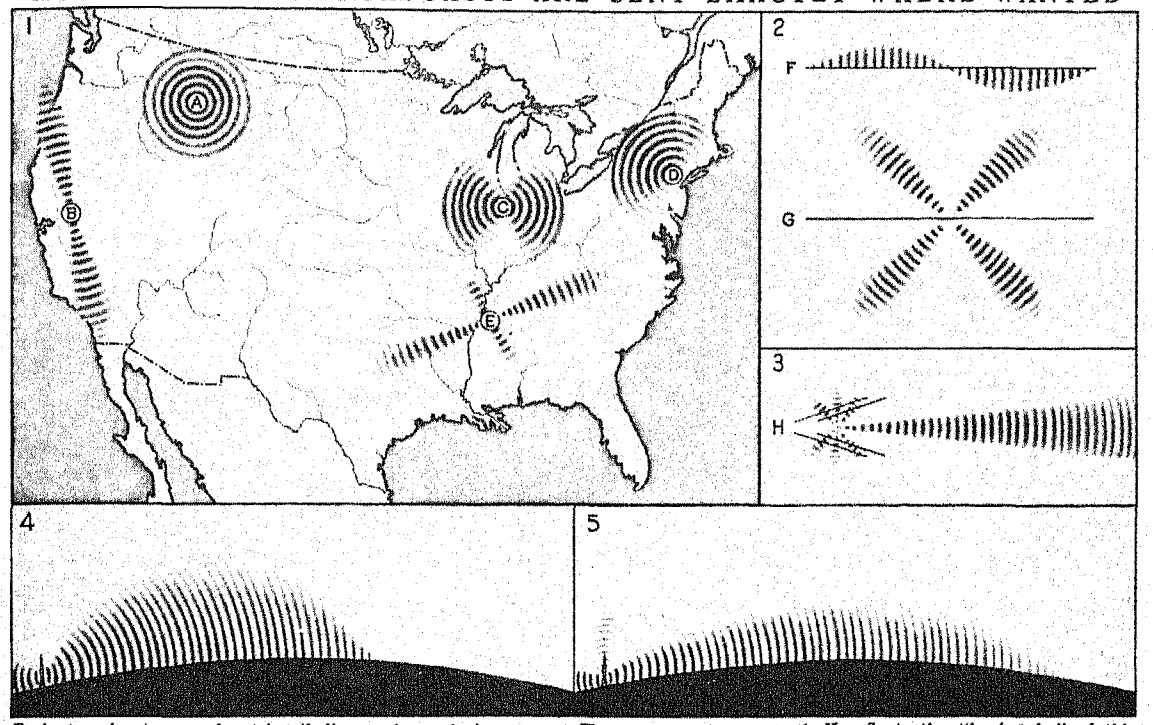
The development of radio circuits and of the vacuum tube has brought in its train countless related inventions and applications. Pictures are now sent through space (*see* Television). Amplifying units, consisting of vacuum tubes and transformers similar to the audio-frequency stages of radio receivers, are used in electric phonographs to reproduce records with superior quality and volume (*see* Phonograph). The extreme sensitivity of the vacuum tube and of its cousin, the photoelectric cell, is used to control all sorts of automatic devices (*see* Automatic Devices). Microphones connected through amplifiers to clusters of powerful loudspeakers send the ordinary speaking voice of an orator resounding to the farthest corner of the largest auditoriums, or carry announcements across football and baseball fields. Talking motion pictures were made possible by adaptations of radio circuits and allied devices (*see* Motion Pictures).

The discovery and development of radio is one of the most wonderful achievements of modern science. As early as 1827, Savary showed that iron needles become magnetized if they are held near a spark discharge. In 1840 Joseph Henry succeeded in producing high-frequency oscillations and showed their effects over small distances. In the same year Samuel Morse, inventor of the telegraph, actually sent signals across a canal in Washington by stringing two parallel wires on the banks and using electromagnetic induction—not quite the same as radio, but close to it.

Invention and Development of Radio

When James Clerk-Maxwell laid down his famous theory of electromagnetism between 1867 and 1873, he predicted the discovery of radio waves. This prediction was realized in 1887 by Heinrich Hertz, who, for the first time, actually demonstrated radio transmission by the spark method. He showed that when a heavy spark was discharged from a Leyden jar, a

HOW BEAMS AND BROADCASTS ARE SENT EXACTLY WHERE WANTED



Early broadcasts spread out in all directions, as shown at A in Fig. 1; but today radio engineers can control the direction and spread of the waves to produce almost any *field pattern* they want. Patterns B, C, and D in Fig. 1 avoid wasting energy over bodies of water, while pattern E is suitable for communication along an airway. The principle used for such *directed transmission* is illustrated in Fig. 2. The wire shown at F is an antenna, exactly one wave-length long. When a complete electrical pulse is in the wire, the two halves of the wire act against each other in producing waves. Hence no waves go out at right angles to the wire nor off the ends. The field pattern of such an antenna is shown at G, with the waves going out at oblique angles. Listeners receive signals from whichever end of the wire is nearer to them. By arranging several antennae to interfere with one another in some directions, but to reinforce one another in other directions, various patterns are obtained. For example, for beam transmission in one direction only, two open V's can be used, as in Fig. 3. The front V creates a narrow two-way beam. The back V reflects the "back lobe" of this beam, and thereby sends all the energy in the desired direction. Only small short-range lobes go out sideways. Figures 4 and 5 show some of the vertical effects obtained by standing an antenna up on end. In Fig. 4, an antenna 1/4th of a wave long is sending energy high into the air. In Fig. 5, a 5/8th-length antenna is sending a flat wave along the ground, and also is sending out a small vertical "sky loop." Strong sky loops of this sort are used to indicate the exact position of airports to planes flying overhead.

corresponding small spark leaped across a gap in a loop of wire 15 feet away. He proved by other experiments that the waves could be reflected and refracted like light waves. Because of Hertz's pioneer work, radio waves are often called *Hertzian waves.*

In 1895 a young Italian, Guglielmo Marconi, began developing Hertz's discoveries into a method for communication at sea. On June 3, 1898, he transmitted the first paid radiogram from the Isle of Wight in England, and on Dec. 12, 1901, he sent the first signals across the Atlantic. On Jan. 23, 1909, the value of radio was strikingly demonstrated when aid was summoned by CQD (now SOS) signals from the steamer *Republic,* after she had been rammed by the *Florida* near Nantucket. (*See also* Marconi, Guglielmo.)

The Slow Growth of Radio Telephony

As early as 1883 Edison had noticed that the filament of his incandescent lamp gave off electrified particles. This "Edison effect" was electronic emission, the basis of radio-tube action; but Edison did not see the importance of his discovery. Not until 1904, when J. A. Fleming produced his vacuum tube with two electrodes—the filament and the plate—was this principle applied to radio. In 1906 Lee De Forest introduced a grid between filament and plate, and produced what he called an "audion." This was the parent of the modern radio tube.

De Forest's audion was found to be the most suitable device for placing sound on the air, and radio telephony developed steadily thereafter. In 1914 E. H. Armstrong produced the regenerative circuit, and in 1916 De Forest broadcast music.

On Oct. 27, 1920, station KDKA at Pittsburgh obtained a license, and on November 2 it broadcast the 1920 election returns. This feat popularized broadcasting, and stations sprang up everywhere. In 1923 Louis A. Hazeltine patented the neutrodyne circuit, and in the same year broadcasts were heard across the Atlantic.

Beams and Field Patterns

A striking advance was *directed transmission.* Marconi led in this work by producing a radio beam in 1922. Within a few years R. M. Foster, G. C. Southworth, and others had developed the field-pattern methods shown in the diagram above, and broadcasting could be adjusted accurately to the areas served.

Similar methods provided radio beams for guiding airplanes.

"All-electric" receiving sets were developed in 1926. The term means a set that can be operated on any lighting circuit. For alternating circuits, the set "rectifies" the current by giving both halves of the cycle the same direction, then passes the current through choke coils and condensers to smooth out the pulsations and create a direct current of uniform strength.

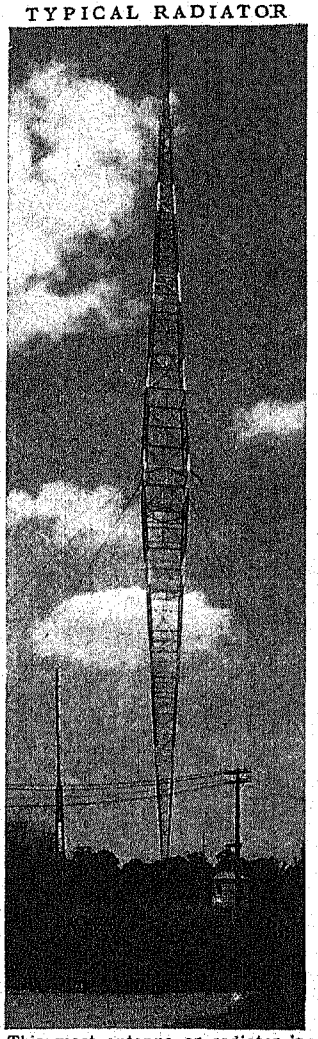
In homes, automobiles, and elsewhere in the United States, there are today about 56 million radio sets. Of the 37 million families, about 84 per cent have one or more sets. Annual expenditures for sets and parts exceeded half a billion dollars. Broadcasting companies have some 75 million dollars invested in equipment, and spend perhaps 45 million dollars a year for programs. Advertising expenditure for radio time varies with the condition of business, from about 85 million to 150 million dollars a year.

Vocational Opportunities in Radio

From the business standpoint, radio has two great fields of activity—direct communication and broadcasting. The communication work includes marine radio, airway control and communication, radio telephony, and similar activities. Broadcasting includes entertainment with commercial programs and educational programs.

Within each of these fields there are opportunities for employment in manufacturing and design, operating, and business management. Broadcasting also offers employment to "talent"—performers, musicians, and announcers, as well as writers and program planners. The technical aspects of radio offer opportunity, just as does any manufacturing and public-service industry, to those who "grow up in the business," by working in the shop or the office. Operators in communication service and operators of broadcasting stations are licensed by the government after passing examinations.

TYPICAL RADIATOR



This mast antenna or radiator is of the type used to broadcast in all directions. Its frame is 550 feet high and weighs 130 tons.

To attain the higher positions in manufacturing and operating, a good education in electrical engineering, with emphasis on radio, is almost indispensable. Many universities and some high schools now give instruction in the various branches of radio. They offer courses in radio engineering, acting, writing, and the business aspects of radio, such as time-selling and station management.

Opportunities for "Radio Talent"

Employment in the "talent" field has the same attractions, risks, and requirements as work on the stage and in motion-picture studios. To achieve a successful career, one should have exceptional talent and good training as a performer. The demands are so exacting, and the work is so strenuous, that one who has only average ability seldom finds a career.

Talent and Training Needed

The larger networks maintain announcer schools for those whose voices, diction, and general qualifications seem suited to microphone work. Actors must be familiar with microphone technique; they must know how to place their voices and how to read from script. If they are accepted, they must expect many hours of rehearsal. Some entertainers receive large salaries, but most get little pay for small and occasional parts. Often, too, employment is short-lived, since many programs are discontinued after a few weeks.

Like the theater and the motion-picture industry, radio broadcasting is an unusually intense business. With its long hours and its many disappointments, it calls for clear thinking and the ability to work in a spirit of cheerful and patient coöperation. Script writing and program planning require abilities similar to those needed in advertising. They also require special knowledge of both the powers and the limitations of broadcasting, which has to entertain and persuade by sound alone. (*See also* Advertising.)

How Radio Programs Are Broadcast

SUPPOSE we are listening to a radio program of music and entertainment. Suddenly the program stops, and a voice announces: "This is station XYZ. We interrupt our program to announce that the steamship *Gloria* is sinking, 50 miles east of Newfoundland, and requests immediate aid. Further details will follow as we receive them." Then the program continues, while we think of the grim scene out in the North Atlantic—the sinking vessel, lashed by a savage gale, and other ships hundreds of miles away plowing to the rescue, with all the power of their boilers and engines.

This incident illustrates the modern miracle of radio broadcasting. It shows us the variety of service, whereby people throughout the nation can sit comfortably at home and hear a world-famous orchestra playing in New York City, or enjoy a performance by

HOW FREQUENCY MODULATION DEFEATS STATIC

BETWEEN 1935 and 1940 a new method for eliminating static and achieving high fidelity was sufficiently perfected to be applied in commercial broadcasting. This method, developed by Edwin H. Armstrong, inventor of the regenerative circuit, is called *frequency modulation* (F.M.).

Until this method was developed, static gave trouble because thunderstorms and certain types of electric equipment emit waves similar to those used in broadcasting. Thus the static waves could not be entirely filtered out by any conceivable device. Frequency modulation uses waves utterly unlike those caused by static. A receiver which is sensitive to these waves does not respond to static.

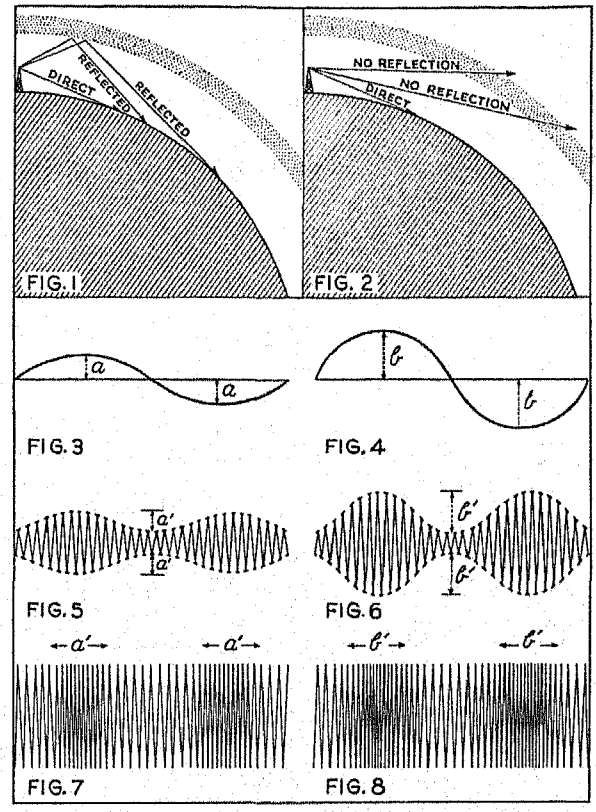
High fidelity in tone is achieved, as explained below, by using a range of frequencies as great as that of the tones themselves. Older methods blurred many of the finer tonal qualities, because they transmitted tones by modulating the strength or amplitude of carrier waves.

One drawback of frequency modulation is the limited range of the extremely short waves used. As explained on page 24 of this article, and as shown in Fig. 1, the comparatively long waves used in amplitude modulation can follow the curve of the earth's surface, because they are reflected from the Kennelly-Heaviside layer.

Waves as short as those used for frequency modulation do not reflect from this layer. The difference is like that between little waves and big ones when they strike a rough breakwater. The little ones get broken up by the irregularities of the breakwater surface, while the big ones are reflected from the surface as a whole. When the extremely short radio waves have traveled far enough from the station to be above the surface of the earth (Fig. 2), the station cannot be heard. Their maximum range is between 50 and 100 miles.

This means that, to cover a wide area, there must be many transmitters at distances varying between 50 and 100 miles. Since the full range of wave frequencies required for frequency modulation cannot be carried over the ordinary network wires, programs must be sent to more distant stations by coaxial cables or some similar means.

Special receivers are necessary to reproduce programs broadcast by frequency modulation. Manufacturers meet this problem by offering sets equipped to receive both the older and the newer type of broadcasting. The Federal Communications Commission expects to let public preference, as shown over a number of years, determine the licensing of each type of broadcasting. The greatest conflict, however, will be with television, since it uses the same wave bands as those employed for frequency modulation.



These diagrams illustrate the principal differences between broadcasting by frequency modulation and the older method of broadcasting. The details are explained in the text.

Frequency modulation can be explained readily by comparing it with the older method described on page 20 of this article. This older method, called *amplitude* modulation, keeps a constant frequency and wave length in the carrier wave, but varies the strength, or amplitude, of each vibration, according to the loudness of the sound being sent. For example, in Figs. 3 and 4 the wavy lines represent respectively a weak tone and a strong one, with strengths shown by amplitudes *a* and *b*. In Figs. 5 and 6 these amplitudes are shown impressed (*a'* and *b'*) upon a carrier wave.

Figs. 5 and 6 show that the frequency, indicated by the spacing of the zigzag line, remains unchanged. Only the amplitude, or width of swing, varies with the intensity of the tone.

In frequency modulation, the frequency varies with the loudness, as shown in Figs. 7 and 8, while the amplitude remains the same. In Fig. 7 the same changes in sound strength shown in Fig. 3 are transmitted by two bursts (*a'*) of higher frequency, corresponding to amplitude (*a*). The louder sounds of Fig. 4 are transmitted, as shown in Fig. 8, by bursts (*b'*) of still higher frequency.

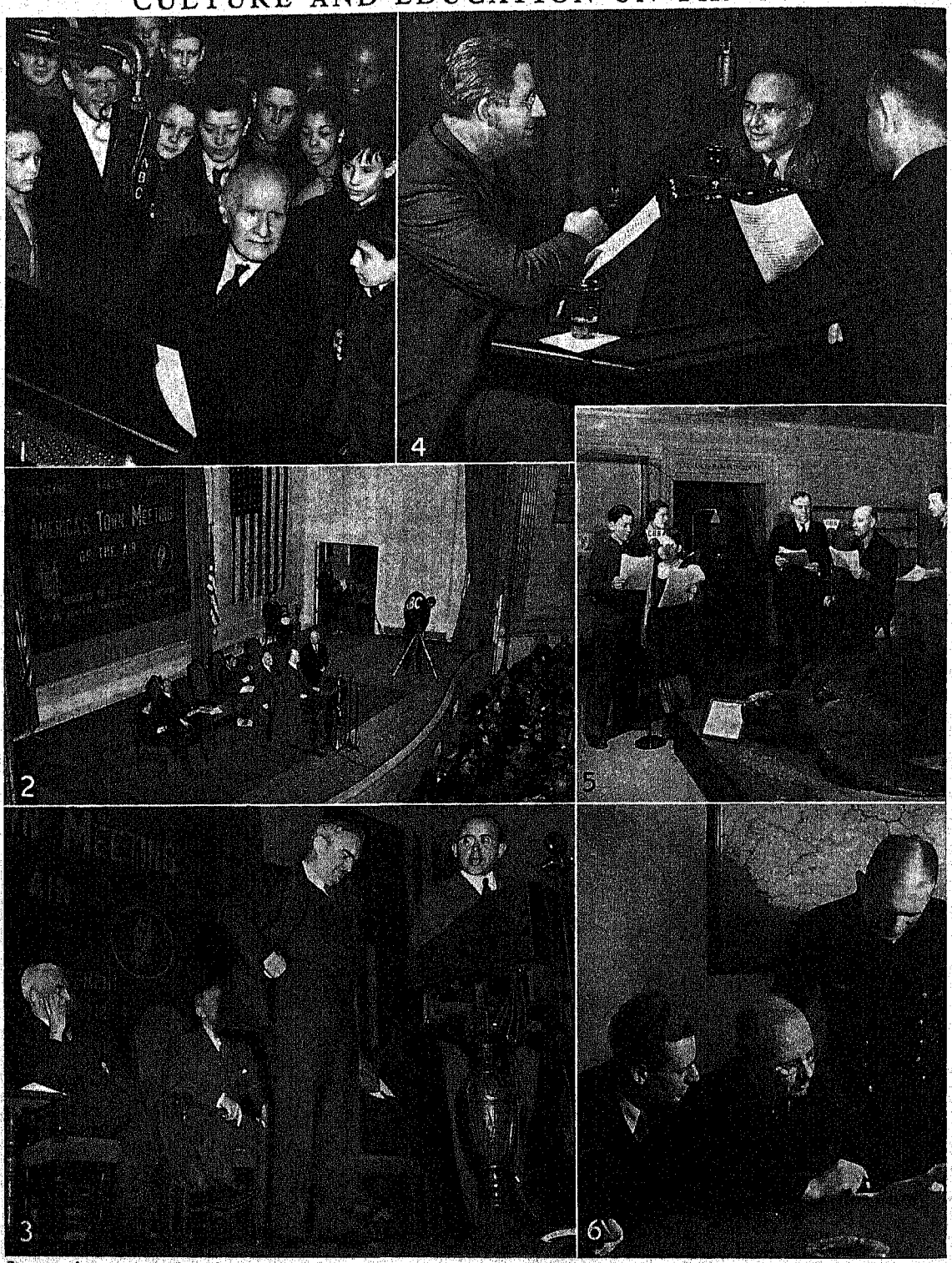
Thus the diagrams show us the wave changes by which each type of broadcasting transmits variations in the *loudness* of sounds. Variations of *pitch* in each case depend upon the number of times per second that the changes take place. In the older type of broadcasting a sound of higher pitch produces a greater number of changes per second in the *amplitude* of the carrier wave. In the newer type it produces a greater number of changes per second in the *frequencies* of the carrier wave band.

Electrical Principle of Frequency Modulation

An earlier section in this article explains that the frequency of the oscillations in a radio circuit depends on two factors—the inductance of the circuit and its capacity. To produce the frequency changes required in the newer methods of broadcasting, one or the other of these factors must be made sensitive enough to undergo changes in response to sound waves. Capacity, which depends on condensers, is more responsive to control than inductance, which depends upon coils. Thus the frequency modulation transmitters operate through changes of capacity in their circuits.

One way to accomplish this is to make the diaphragm of a microphone act as one plate of a condenser in the radio circuit. Thus every change in sound that strikes the diaphragm varies the capacity of the sending circuit and thereby changes the frequency of the outgoing signal. This principle is reversed in the receiving set.

CULTURE AND EDUCATION ON THE AIR



Success of programs such as these shows how eager people are to gain knowledge by radio. 1. A nation-wide audience is listening as Dr. Walter Damrosch plays and talks about good music to an informal audience grouped around his piano. 2 and 3. Here we see one of the widely followed "Town Meetings of the Air," with noted speakers debating a question of the day, and a microphone set to catch questions from the audience. In the close-up picture, one debater ponders his answer to a point made by his opponent. 4. Three University of Chicago professors conduct a "Round Table" discussion. 5. The "American School of the Air" broadcasts from the American Museum of Natural History, New York City. The picture shows school pupils participating. 6. A news commentator on the war in Europe is about to speak from Berlin. Two official censors are giving their last-minute approval to his text.

Hollywood stars, and also hear the latest news as it occurs. A talk by the president of the United States, by the head of a great industry, or by a labor leader demonstrates how the voice of one man can instantly reach millions of people. While housewives are busy with their tasks, they can listen to talks about new recipes, new foods, and household helps. People in isolated communities and men at lonely posts can keep in touch with the world. In a few seconds, the police in several states can be notified to watch for wanted criminals. Warnings can be given of storms and floods.

CLOSE-UP VIEW OF A STUDIO BROADCAST

The orchestra conductor near the microphone is catching a signal from the director in the control room. The director holds up three fingers, meaning, "You have three beats of the time clock left." In the right-hand control room, the actors who are to follow await their cue.

How are these radio broadcasts sent out? Let us visit a large broadcasting station and watch a program in progress.

Inside a Broadcasting Studio

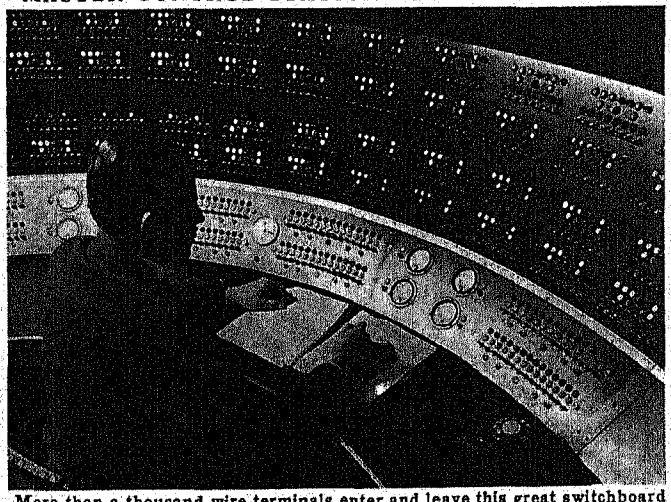
Large stations have many studios, from small rooms for single speakers, to great audience halls large enough for an orchestra and several hundred spectators. In all the studios, the walls and the ceiling are covered with sound-absorbing material to prevent echoes.

Shortly before the broadcast starts, the announcer warns us that the microphones pick up every sound, and asks us not to talk during the performance. He also asks us to stop applauding at a signal from him, to permit the program to continue. Then a red signal light flashes on, warning us that our studio is "on the air." The announcer reads his introduction for the program, and the performance begins.

Then we look through a sound-proof window into the adjoining control room. There we see an engineer, who sits before a control board with many instruments, and a producer, who directs the broadcast. The producer can watch the performance through the window, but all he hears is the sound that comes through a loud-speaker.

When the music of the program starts, we may notice a tendency to blare. Instantly the engineer twists a knob on his control board, until his sound meter reads approximately 30 decibels. This, we are told, is the favorable volume, or measure of loudness, for music, while about 20 decibels is correct for voice volume.

MASTER CONTROL STATION FOR RADIO TRAFFIC



More than a thousand wire terminals enter and leave this great switchboard and signal station. It is one of three in Radio City where studio and station hook-ups are made and nationwide schedules are distributed.

Presently the producer gives a hand signal to the performers to speed up. He must bring the program to an end at exactly the right time, "on the head." He times the performance from a script which shows the second at which key parts of the program should be reached. If the performers fall behind or get ahead of schedule, the producer signals them to go faster or slower.

Programs from Near and Far

In another studio, performers are getting ready for the program which is to follow the one we are watching. In the master control room, an operator is ready to switch to this other studio at the proper second. Meanwhile he watches his instruments to see that our program is being properly sent out to the transmitting plant, where it is broadcast into space. This station is usually

several miles away in the country, to escape interference from steel-framed buildings and to avoid electrical disturbances from city circuits. The program is carried to it over wires leased from the telephone company.

The master operator also switches in all network programs. Usually these programs are sent from wherever they are being performed over leased wires to the local stations that are members of the network. Each station then converts the incoming program to its own wave-length and broadcasts it. If storms or floods interrupt the wire service, the network companies use a short-wave radio to bridge the gaps. Short-wave hook-ups are always used for transatlantic programs and for broadcasts from airplanes or ships at sea.

Painstaking Preparation for Broadcasting

Behind the smooth flow of the broadcasts that we hear on our radios is an amazing amount of preparation. Most programs are planned well in advance by the *program departments* of the stations and of advertising agencies. Highly trained writers in *continuity departments* prepare the scripts. Actors, musicians, and others rehearse each program hour after hour until it fits the allotted time. The *publicity departments* send out notices about the programs for the radio pages of newspapers.

A large station's daily program begins early in the morning with news flashes, setting-up exercises, and lively music. Between breakfast and noon, most stations offer household hints and dramatic serial stories intended for housewives. Then come music, drama, educational features, and broadcasts of athletic events. Children's programs are given between four and six o'clock in the afternoon. The hours thereafter are reserved for the most important programs, because the greatest number of people are listening then.

Sound Effects and Electrical Transcriptions

In the early days of broadcasting, *sound effects*, such as the noises of storms and airplane motors, were produced by devices operated in the studio during the performance. Today many such effects are obtained from phonograph records previously prepared. This so-called "electrical transcription" produces better effects, since the producer can try for the desired effect again and again until a perfect recording is obtained. It is also cheaper, since the records can be rented to stations for much less than it would cost the station to produce the effect in its own studio.

Complete programs, as well as sound effects, are transcribed for rental to small stations. Transcriptions also overcome the difficulty caused by differences in time from coast to coast. Nine o'clock at night, for example, is a fine time for reaching the East. Listeners in the Middle West could hear the program at eight o'clock, which is also good. But the Rocky Mountain States would hear it at the less favorable hour of seven, and the Pacific coast at six. Therefore transcribed programs are prepared for later use by western stations. To prevent deception, however, the law requires that such performances be announced as transcribed. "Live" performances are usually transcribed even if the transcription is not to be used. The record permits a "play back" if controversy or lawsuits arise from the performance. Advertisers can study their past programs and important speeches can be permanently preserved.

Advertising Supports American Broadcasting

The total cost of broadcasting on the tremendous scale prevalent in the United States is enormous. How can it be made to pay for itself?

Radio manufacturers started broadcasting soon after the end of the first World War to stimulate the sale of receiving sets. Some newspapers and other enterprises also established stations to advertise themselves. When the novelty wore off, stations had to give better and more expensive programs to hold their listeners. In 1924 stations began to seek additional revenue by selling time to advertisers. Advertisers found this profitable, and soon they were spending millions of dollars a year to buy "time on the air."

Charges are based on the potential size of the audience, which depends on the range of the station or network of stations and the time of day. Early morning and late evening hours are the cheapest. The hours from about 6:00 to 10:00 p.m. are the most expensive.

A one-minute announcement from a small station may cost only $1, but from an important station with a huge audience it may cost $70 or more. An hour on a national network with star performers may cost the advertiser $30,000 or more. About $17,000 of this goes to the network for the use of its facilities. The rest is paid for performers and script.

The Growth of Networks

Networks, or combinations of stations giving the same programs, sprang up when many small stations found that they could not afford to provide programs of sufficiently high quality to hold listeners. They arranged connections by wire with large stations noted for their fine programs, and the group of interconnected stations formed a "regional network." The managers of the network then sold time over the entire system to advertisers.

The regional networks pointed the way to "national hook-ups," or *coast-to-coast chains*. In 1926 the National Broadcasting Company was formed; and soon had two chains, the Red Network and the Blue Network. In addition to their own outlets, the chains provided for larger advertising coverage by making contracts for hook-ups with local stations. In 1927, the United Independent Broadcasters, Inc., later the Columbia Broadcasting System, was formed. In 1934, the Mutual Broadcasting Company was organized. In 1942, the two chains of the National Broadcasting Company were separated at the request of the Federal Communications Commission, and the independent Blue Network Company, Inc., was formed.

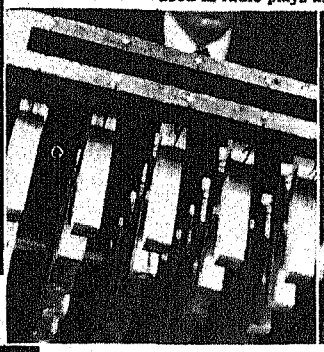
Foreign Broadcasting Systems

In most foreign countries broadcasting is either conducted or rigidly controlled by the government. This is chiefly because of its tremendous possibilities for

WHERE THE WRONG THING SOUNDS RIGHT

Few noises sound like themselves over the radio. Besides, many of the noise-makers, like cows or locomotives, could not conveniently be brought into a studio. Here are some of the "sound effects" commonly used in radio plays and news broadcasts.

A crackling fire may be only crushed cellophane.



Pegs striking a table top imitate a marching army.

Hoofs on a hard road are clacking coconut shells.

Something moving in the bushes is twisted straw.

The hero floors the villain by punching a rubber sponge.

A rare exception—an egg-beater can imitate itself.

spreading propaganda. In many countries it is financed by collecting license fees from owners of receiving sets, and no time is sold to advertisers.

In England most broadcasting is done by the British Broadcasting Corporation (BBC), though a few unimportant privately-owned systems are allowed to operate. The Corporation frankly serves the interests of the government, but it also tries to meet the preferences of different "interest groups." It takes no commercial advertising. Programs are transcribed to be broadcast to the dominions and the colonies at suitable hours.

In Germany and Italy radio is used largely to spread propaganda, both internal and international. German broadcasting is supervised by the minister for propaganda and enlightenment. In Italy radio is theoretically a private monopoly, but programs are censored by the government. In both these countries special attention has been given to foreign propaganda broadcasts of news and entertainment in the languages of the countries at which the programs are directed.

The Soviet government controls all broadcasting through subsidiary organizations. It emphasizes educational and propaganda programs. Owners of receiving sets pay a fee, but most of the people hear the programs from loudspeakers in schools, recreation halls, and other public places.

Social Problems Created by Radio

LONG before broadcasting came into existence, all important governments had been compelled to impose certain controls on radio, if only to prevent hopeless confusion on the air. In the United States, for example, the Radio Act of 1912 required all stations to obtain a federal license from the Department of Commerce, largely to prevent interference with stations which maintained communication at sea. At first the Department granted licenses freely for frequencies not used for marine communication. By 1924, however, there were more than a thousand stations and all available frequencies were in use. Many stations were increasing their power, and so were interfering with distant stations on the same frequency. Something had to be done, or broadcasting would soon be a chaotic jumble of competing programs.

The Department of Commerce then refused to grant more broadcasting licenses, and in 1927 Congress established a Radio Commission, with broad powers to regulate broadcasting. In 1934 its duties were taken over by the Federal Communications Commission.

Under this control the country is divided into seven radio zones, and the stations are grouped into four classes. The *clear-channel* stations have exclusive use of their frequencies and operate with not less than 5 kilowatts of power nor more than 50. The *high-power regional* stations have exclusive use of their frequencies over several zones, and use not less than 5,000 watts of power. *Regional* stations use not more than 2,500 watts in the daytime, and from 250 to 1,000 watts at night. This confines their broadcasts within single zones. *Local* stations use not more than 250 watts during the day and 100 watts at night.

The Question of Censorship

Out of this federal licensing system has come the question of government censorship of programs. A de-

gree of indirect censorship was inevitable, because the number of stations wanting licenses was greater than the number of available frequencies. In granting licenses the commissioners therefore based their decisions largely on the *public interest.* This meant, not only the interest taken by listeners in the different stations, but also the Commission's opinion of how well the public interest was being served by each station. To apply this principle, the Commission had to decide what constituted high quality and valuable service. This amounted to indirect censorship, since the Commission gave licenses for only two years and could shut down any station after that time.

Pros and Cons of Government Control

Broadcasting stations object to this control. They point out that they have spent large sums for equipment, to train a staff of workers, and to win listeners. This investment, they say, should give them a property right in their licenses. They hold that the government should be entitled to limit or revoke a license only for offenses against law, order, or decency.

The Commission claims that such a rule would "freeze" progress, because the physical nature of radio broadcasting sets it apart from other forms of communication. Any number of newspapers or speakers in public halls can compete for public attention without interfering physically with each other. Competing telegraph and telephone lines can be strung along the same route. But only one radio station in a region can use a frequency at one time. If a station makes poor use of its right, the public cannot afford to wait until the station is forced out of operation by loss of listeners. The Commission should have the right to give the frequency to someone who will make better use of it.

War Time Censorship

Immediately after the United States entered the second World War, radio was subjected to the regulations of the Office of Censorship. Programs in which members of the studio audience take part were subject to strict scrutiny to prevent information being given to the enemy under cover of seemingly innocent remarks. Amateur stations were banned, except for official services, and the nation-wide monitoring system was expanded and perfected to detect secret sending apparatus.

Education on the Radio

From the beginning, far-sighted men foresaw the vast possibilities of radio as an aid in spreading knowledge and promoting culture. Within a year after KDKA started commercial broadcasting, many colleges and institutions had started to give educational programs.

Some of these programs offered crop reports, information about household management, and talks on political, social, and business problems. Others offered addresses by noted men and women, classics of literature, drama, and music, and other material of general educational and cultural value. Classes were organized in definite studies. Some of these classes were home groups. Others were set up in schools, by having pupils throughout a school system listen to broadcast lessons.

Some of these efforts proved highly successful; others did not. To be effective, an educational program, like a commercial program, must be prepared by skilled writers and presented by skilled speakers. Most educational projects could not afford to hire a staff of such workers; and often those in charge of the programs failed to realize the kind and amount of preparation needed.

Educational versus Commercial Broadcasting

Many leaders in education urged that commercial broadcasting companies should give free time on the air to educational programs. They argued that no company had a right to use its monopoly entirely for its own profit, by selling all the good hours to advertisers. They also censured the commercial companies for putting on some programs which they considered to be trashy, sensational, and degrading to public taste.

The commercial broadcasters replied that before a station could help in educational work it had to earn money enough to keep going. If those who were interested in promoting education and culture could not provide the money needed, the station had to get it from advertisers. To do this, they had to attract listeners, and they could not afford to load their programs with dull lectures and other material of limited appeal. Further, they called attention to the educational and cultural value of their sustaining programs of symphony concerts, grand opera, debates, and round-table discussions by noted speakers. They pointed to the fine quality of many advertising programs. They said that schools reported greatly increased interest in good speech, because of the example set by station announcers and others. Broadcasts of fine symphonic music had led to the establishment of good orchestras in many cities and had raised the standards of musical taste throughout the nation.

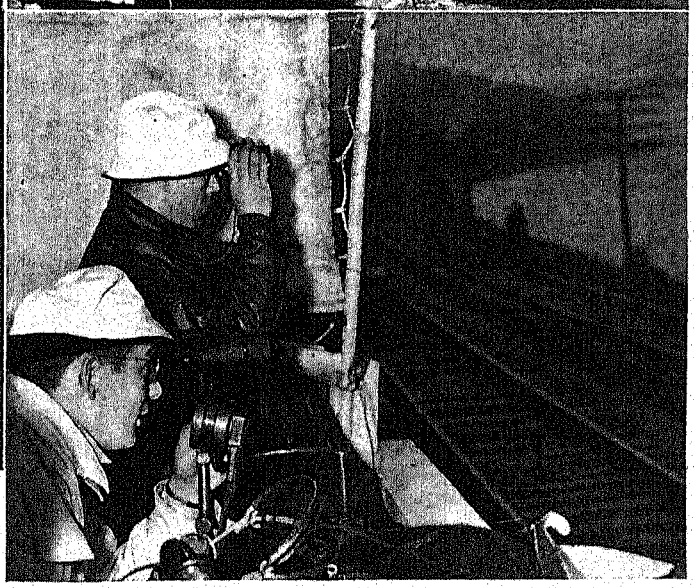
Controversy and Propaganda on the Air

All network companies and most stations are constantly besieged by individuals and groups who want to promote various causes, and by others who demand that certain causes shall not be presented. Dealing with such demands is one of the most difficult problems in radio broadcasting, especially in the United States, where the companies and stations are supposedly free to do whatever they think best.

Some local stations frankly take sides on controversial topics, just as newspapers do. The networks, however, and many large stations that serve a wide region try *not* to take sides. They settle such problems as best they can by applying two tests: Is a question important enough to deserve time on the air? If it is, how many sides are there to the question? Once that is decided, the company tries to see that every side gets a fair amount of time.

In many foreign countries an even greater problem is that of international propaganda, broadcast by nations into the territories of other nations. In the early days of broadcasting, the new agency seemed to

BROADCASTING NEWS EVENTS "ON THE SPOT"



Above, we see a street interview. The announcer has a microphone on his wrist and an antenna in his walking stick. Upper right, a "machine-gun mike" picks up the distant sound of an airplane. Lower right, the description of a rowing race is being sent from a train moving along a river bank.

offer splendid possibilities for promoting international understanding and good will. The supposition was that peoples who heard programs and discussions from other lands would learn to understand those lands better. Government use of radio has worked out the other way. Rival nations drench each other with violent nationalistic propaganda. High-powered European stations seek to sway public opinion in other continents. To counteract such propaganda, United States broadcasting companies, with government cooperation, have greatly expanded their services to foreign countries. Some nations meet the problem of keeping out foreign propaganda by "jamming the air"; that is, they operate stations on the wave-lengths used by rivals, and thus interfere with reception.

Radio as a Problem for Parents

Listening to the radio has become a leading factor in the leisure activities of the American family. It exercises a profound influence on the tastes, interests, and character development of children. Because it can be done without effort and without thought of expense, it tends to occupy more of their time than either reading or attending motion pictures.

Child specialists agree that parents should supervise, not only the kind, but also the number of radio programs that are turned on in their homes. They believe that in many cases children fall into the habit of turning on the radio and listening to it to kill time rather than from a genuine interest in what they hear. They feel that this habit tends to weaken a child's taste for active experiences and they suggest that the child will enjoy the radio more if he confines his listening to a few favorite and varied programs each week.

(The use of radio in the transmission of pictures and facsimiles is covered in the article on Television and Telephotography. For other related subjects, *see also* Electricity; Electronics; Radiation.)

RADIUM—*Once a* RIDDLE *of* SCIENCE

The Most Costly Substance in the World and How It Was Discovered by the Brilliant Wife of a French Scientist—Its Wonder-Working Powers that Led Science to Revise the Entire Theory of Matter

RADIUM AND RADIOACTIVITY. "If the whole ocean were mercury," said the alchemist, "I could turn it all to gold," so firm was his belief in the possibilities of "transmutation," which to him meant changing baser metals to gold. When 19th-century scientists established the atomic theory of chemistry, and the principles of conservation of mass and energy in physics, the alchemist's transmutation was considered a foolish dream. Yet it had been going on for ages in nature, and in 1896 the distinguished French scientist, Henri Becquerel, found the first clue pointing to it.

In an effort to enlarge knowledge of the newly discovered X-rays, he had been experimenting with compounds of the metal uranium. In the course of the experiments, he found that the compounds would cause images on photographic plates, no matter how carefully they were shielded from the light. This effect was quickly found to be electrical in nature, since the presence of such ores would discharge an electroscope, and led many to suspect that the phenomenon had something in common with the newly discovered "electrons" (*see* Atoms and Electrons; Electricity). Meanwhile another line of investigation, suggested by Becquerel's findings, was leading to a discovery which revealed transmutation actually at work, and revolutionized all science's theories concerning the nature of matter.

MADAME CURIE

Discoverer of Radium

Becquerel Effect a Clue for the Curies

Mme. Marie Sklodowska Curie and her husband, Pierre Curie, professor of physics at the Sorbonne in Paris, learned that many extracts of uranium ores gave a stronger "Becquerel effect" than uranium itself. This they thought could only be caused by some hitherto unknown element being contained in the ores, and they started searching for it. The work was extremely laborious, for it soon became apparent that a ton of the ores would yield only minute traces of the element sought. In 1898, however, enough was obtained in the form of a chloride to permit identification as a chemical element. It was found to have an atomic weight of 226, to belong to the alkaline earths like calcium, to be a white metal melting at about 1,292°F., and to combine readily with water, air, and the acids (*see* Chemistry). But these chemical details were scarcely of any interest in comparison with one startling fact: the new element seemed to be constantly *exploding*, giving off enormous amounts of energy in proportion to its bulk, and yet seeming (at the time) to suffer no loss of weight whatever. It was this which caused the element to be named *radium*, and its emission of energy *radioactivity*. The Becquerel effect now was seen to be due to the radioactivity existing in uranium, to a less degree than in radium.

This seeming defiance of natural law challenged the attention of the scientific world. In 1899 Rutherford, working with uranium, answered part of the riddle when he found that the effused energy was of at least two different kinds, which he named *alpha* and *beta* rays. Villard soon after found a third kind, called *gamma* rays. All these rays were produced in strength by radium. By 1903 Rutherford and Soddy were able to give the explanation of exploding radium, which in its general features is accepted today.

Nature of Radium

According to them, the radium atom is composed of a core of relatively dense particles, each one of the same composition as the nucleus of a helium atom. That is, it contains electropositive particles (now called *protons*); and mingled with these, or surrounding them, are much less massive electronegative particles, then already identified as *electrons*. Thus was the theory of the electrical nature of matter born—for if it was true that radium was nothing but a mixture of electroactive particles, then, said those pioneer investigators, it probably would prove true also of all the other elements. As we know now, this prophecy has been fully developed and tested by hundreds of independent experiments.

The explosive powers of radium are due, according to these and other investigators, to the fact that the two kinds of particles are loosely bound in the atom, and occasionally some break loose and shoot forth from the atom with enormous speed. Alpha rays consist of positively charged particles shooting out from one to three inches from the nucleus at speeds of about 6,000 and 12,000 miles a second—from 5,200 to 10,500 times as fast as the swiftest military rifle bullet. Beta rays are negatively charged electrons, erupting from the atom at speeds sometimes nearly equal to that of light. Gamma rays puzzled scientists for many years; but now they are thought to be *photons*, or bundles of light energy (*see* Radiation). They act like X-rays of extremely short wave-length.

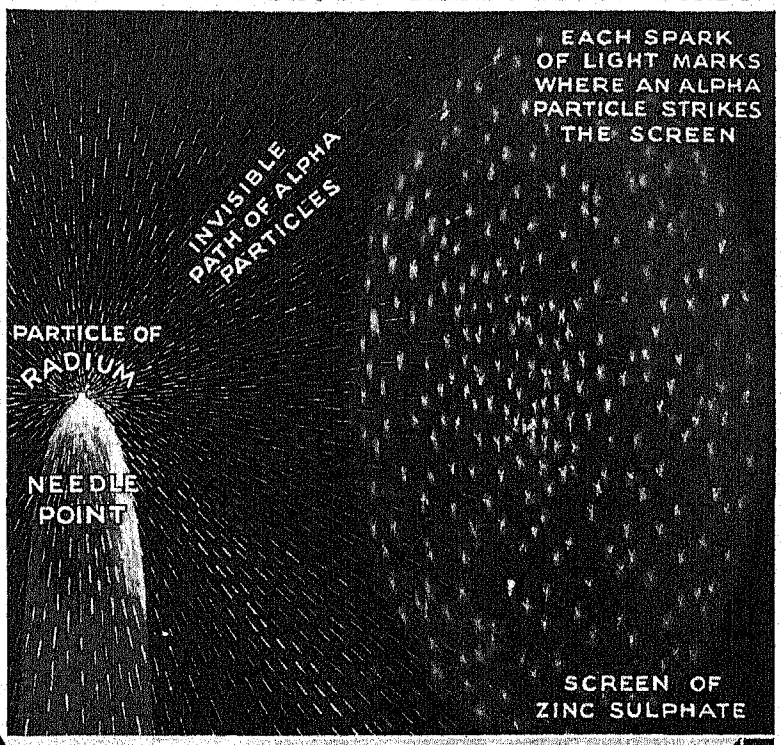
Penetrating Power of Rays

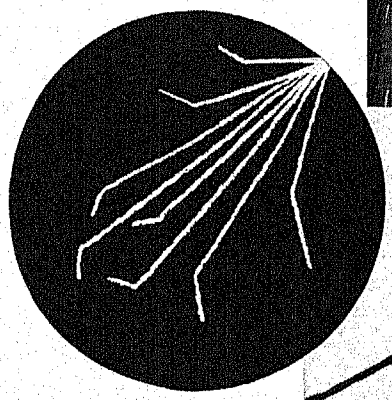
Each type of radiation has the power to penetrate matter to distances depending upon its total energy. Alpha rays can penetrate aluminum foil up to one-tenth of a millimeter thick; beta rays can penetrate four millimeters of such foil, or one millimeter of lead; while it

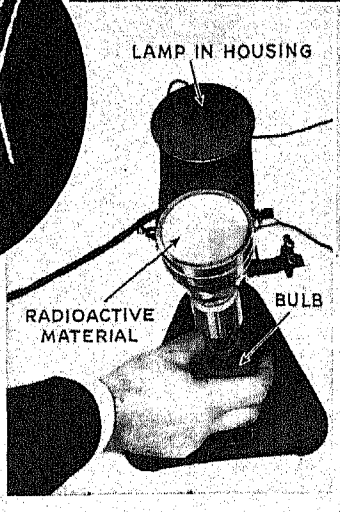
takes a piece of iron one foot thick to stop the intensely penetrating gamma rays.

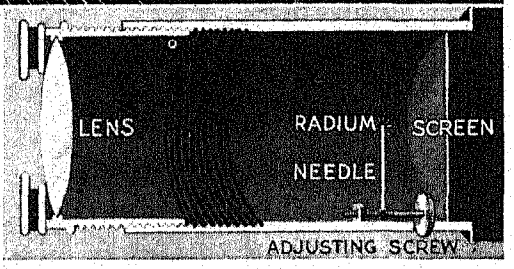
How radium fulfils the alchemist's dream of transmutation follows from this. Scientists found that the alpha particles (consisting as we have seen of helium nuclei) promptly gathered in the electrons they needed to become stable helium atoms. This was the first transmutation. But there were others. Alpha particles are emitted at such a rate that if an ounce of radium were obtained, it would give off over 385 billion such particles a second. Naturally, no mass of radium could do this forever, and still remain radium; for after an alpha particle had left an atom, those remaining would rearrange themselves, and the atom of radium would become an atom of something else. This proceeds at such a rate, scientists have found, that in 1,700 years, one half of any mass of radium will have become "radium emanation," or radon (sometimes called niton), an inert gas resembling helium. Part of the radon will in turn have become a still lighter element, polonium. The same is true of other radioactive elements, such as uranium and thorium. In fact, the radioactive elements may be arranged in three series, and throughout each series transmutation takes place: the uranium-radium series, in which some of the successive products are uranium, ionium, radium, radon, and polonium; the thorium series, and the actinium series, in both of which successive products are known by their parent names, with letters designating the successive products of transmutation, as thorium B, thorium C, and so on.

SEEING THE "SHOTS" THAT RADIUM FIRES









The picture above explains the way radioactivity is observed in a spinthariscope (lower right). A simple way to demonstrate the cloud effect devised by C. T. R. Wilson in 1897 is shown at the left. The closed glass vessel with flat top is partly filled with water, and a tiny bit of radioactive material is mounted to shoot alpha particles across the larger upper chamber. Squeezing the bulb compresses air in the upper chamber; releasing it suddenly reduces pressure. This causes fog to condense on any particle present. Any gas molecule struck by an alpha particle becomes ionized, and gathers fog. This makes it large enough to reflect a strong light, and its track can be photographed, as in the picture at the far left. Scientific experiments use more elaborate apparatus.

Where does this process of transmutation end? Curiously enough, where the alchemist often started. He often sought to transmute lead into gold. Nature's transmutation by radioactivity *results* in lead. When the radioactive substances, by successive transmutations, become lead, their atoms achieve electrical stability; no further explosions occur; and the lead remains lead.

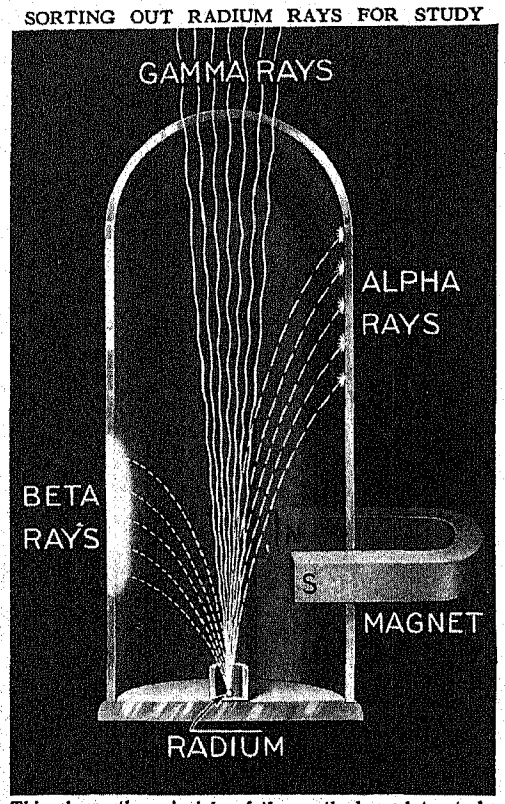
How Long Does Radium Last?

Different transformations in these series take enormously different times, the customary unit being the "half-period"—that is, the time taken for half of a

given mass of radioactive substance to become transmuted to the next substance in the series. The half-period of uranium, the heaviest element and parent substance of radium and perhaps actinium, is the longest, amounting to 5 billion years. For ionium it is 500,000 years; and for radium 1,700 years. Some of the half-periods are only days or minutes, and for actinium C, only two-thousandths of a second. Estimating the relative amounts of radioactive substances, lead, and helium in different minerals, and applying these half-periods to see how long radioactivity must have been going on to achieve such proportions, is one way of estimating the age of the mineral, and from that, of the earth (*see* Earth).

The study of radioactivity depends largely on the fact that the alpha and beta particles can be deflected in their flight by strong electric or magnetic fields, as shown in the drawing. The flight of the particles can be made visible by allowing them to strike a screen of zinc sulphide or similar material, where they cause fluorescence. When the electric or magnetic field is applied, the fluorescent spots shift. The amount of their deflection produced by a field of known strength indicates the mass and electrical charge of the particles. Another method uses the Wilson cloud chamber, illustrated on the preceding page.

SORTING OUT RADIUM RAYS FOR STUDY



This shows the principle of the method used to study radium rays—deflecting the oppositely charged alpha and beta rays in opposite directions with a magnetic field, while gamma rays are not deflected at all.

The power of the alpha rays of radium to transmute certain other elements at will was discovered by Rutherford in 1919. He bombarded nitrogen atoms with these rays and broke them up into fragments which turned to hydrogen and carbon. In the same way boron broke up into hydrogen and beryllium; aluminum into hydrogen and magnesium; and so on.

Artificial Radioactivity

Another great step was the discovery in 1934 that *artificial radioactivity* could be set up in many substances by bombarding them with alpha particles from polonium. This discovery was made by Irene Joliot-Curie, daughter of Madame Curie, and her husband Frederic Joliot. They found that atoms of aluminum after bombardment build up into unstable atoms of phosphorus, which break down again to silicon, emitting as they do so particles similar to those from radium. Within a few weeks Prof. Charles C. Lauritsen of Pasadena, Calif., announced that he had made boron and other elements radioactive with an "electric gun." This device draws a stream of hydrogen nuclei, helium nuclei, or other atomic particles into a powerful electrical field, which speeds them up tremendously and then sprays them against the atoms which are to be made radioactive. More than 70 elements have been successfully activated and transmuted by these and similar methods. The fact that artificial radioactivity is short-lived is important in medicine, as we shall see.

Radium as a Healer

Radium and radon (the gaseous emanation of radium) are used in the treatment of cancer and other growths. A capsule of the material is placed near the growth and the flying particles either kill or reduce the harmful cells. The effects are extremely powerful over a short range—so powerful that the capsule must often be removed before all the harmful cells have been reached, for fear of injuring vital tissue near by. Treatment of a large area of the body is impossible. Experiments indicate, however, that harmless substances like common salt, made temporarily radioactive, may perhaps be injected into the body, do their work gently, and lose their power before any harm is done.

The high price of radium, due to its rarity and the difficulty of extracting it from its ores, has further limited its use in medicine. But as new sources have been discovered the price has dropped in 10 years from $3,500,000 an ounce to $700,000. Artificially radioactive substances cost only a small fraction of this.

Radioactive Substances and Ores

The chemical elements which are radioactive in the natural state, in order from the heaviest to the lightest, are uranium, protoactinium (formerly called ekatantalum), thorium, actinium, radium, radon or niton, polonium, rubidium, and potassium. Radium occurs in pitchblende, a black mineral containing uranium oxides, lead, nitrogen, and traces of the helium which has been evolved; also in carnotite, uraninite, and in small amounts in other minerals. It is always associated with uranium and usually with lead.

The first specimens of radium, isolated by the Curies in 1898, came from pitchblende deposits at St.

Joachimsthal, a mining district of Bohemia, now in Germany. For ten years during and after the World War, carnotite and other ores from Colorado and Utah were the best source of radium. The richer ores of the Katanga deposits in the Belgian Congo have since produced much of the world's radium. Extensive deposits, said to yield ten grams to 100 tons of ore, have recently been opened in the Great Bear Lake region of northern Canada, almost on the Arctic Circle; airplanes carry the ores 4,000 miles to the refinery. Bulgaria, Russia, and South Australia also have deposits.

Radium salts are prepared from their ores by dissolving the uranium fraction in suitable solvents, separating as far as possible the minerals known not to contain radium, then crystallizing and recrystallizing, the concentration of radium being higher with each crystallization, until finally the purified salt is obtained.

RAIL AND COOT. Thin compressed bodies, short rounded wings, stumpy tails, and strong legs characterize the family *Rallidae*, to which the rails, coots, and gallinules belong. About 180 species of this family are distributed over the world, 15 inhabiting North America. Most rails have long, slightly curved bills, but the beaks of the coots and gallinules are short and stout. All live and nest among the rushes of the swamp, feeding on insects, small forms of water life, and seeds.

These birds are like chickens. When frightened they run rather than fly, and their chatter in the marshland sounds like the cackling and clucking of domestic hens; so it is not strange that people call them mud-hens.

The rails are a secretive lot, keeping under cover in the daytime and coming out towards evening to walk along the edges of the pond. During the hunting season many are killed as game. When flushed from the reeds, they make easy targets for the sportsmen as they wing their awkward way with dangling legs. The birds migrate southward in the fall and their short wings carry them surprisingly far. Many make non-stop flights across the Gulf of Mexico to their winter home in South America; others cross the sea to distant Bermuda.

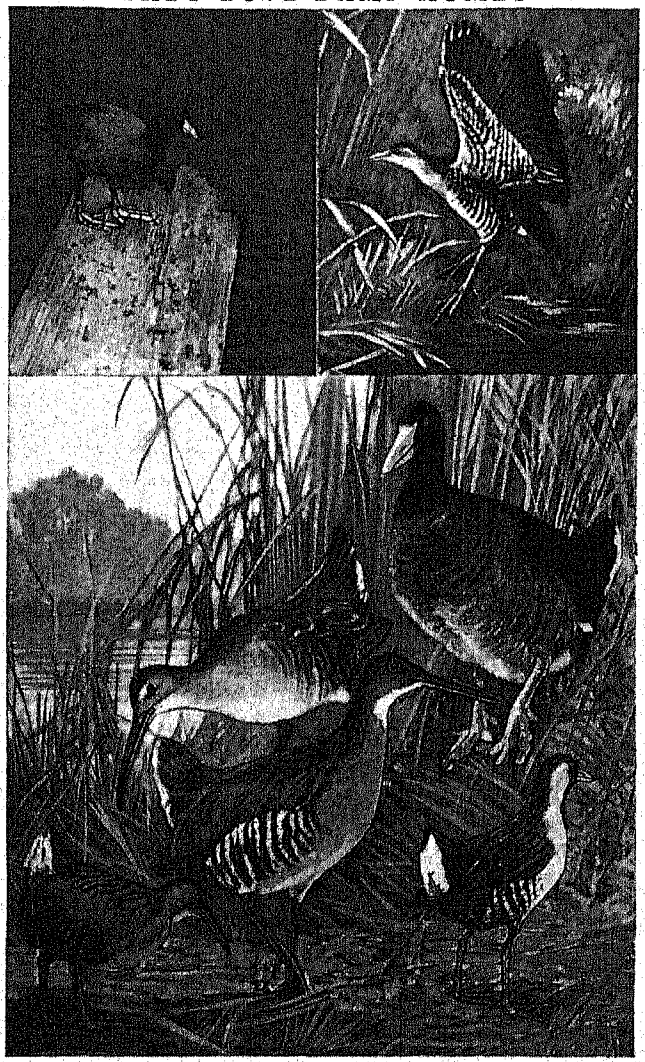
Most rails prefer fresh-water sloughs, but the salt marshes of the Atlantic coast are the haunts of the clapper rail. The smallest American rail is the black rail, 6 inches long; the largest is the majestic king rail, measuring more than 17 inches. The sora is the most common and widely distributed American rail.

Coots push themselves along through the water with feet well adapted for swimming, with each toe fringed with a scalloped membrane. The American coot is about 15 inches long, with slate-colored plumage that merges into black on the head and neck. Its bill is ivory-white and its frontal plate light brown. Its nest is a raft made in the water from dead stems woven together like a wicker basket and anchored to the reeds. The coot lays from 7 to 16 eggs.

The gallinules swim about on ponds and lakes, but also spend much time in bogs. They are found mostly in the southern United States, but the Florida gallinule breeds as far north as southern Canada. The plumage is slate-colored, tinged with brown on the back, and the bare plate on the forehead is red. The purple gallinule is named for its purple plumage; it wears a blue shield over its carmine-colored bill.

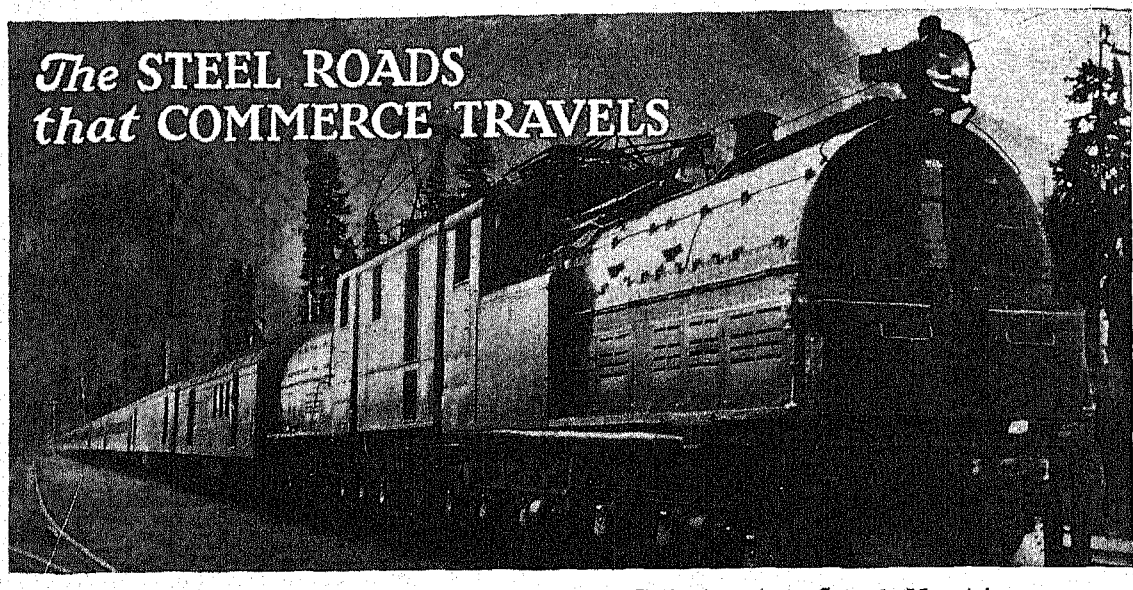
The scientific name of the sora rail is *Porzana carolina;* king rail, *Rallus elegans elegans;* black rail, *Creciscus jamaicensis sloddardi;* American coot, *Fulica americana americana;* Florida gallinule, *Gallinula chloropus cachinnans;* purple gallinule, *Ionornis martinica;* clapper rail, *Rallus longirostris.*

THEY LOVE DAMP HOMES



In the upper left corner is a Coot, ready to pounce on some water insect. Next to it is a Sora Rail alighting on its nest. In the damp marsh below, you will recognize the Coot by its black head. Next to the Coot is a Clapper Rail; below, a King Rail. The smaller bird at the left is a Virginia Rail and at the right another Sora.

The STEEL ROADS that COMMERCE TRAVELS



An Electric Locomotive Pulling a C. M. St. P. & P. Train through the Cascade Mountains

A LITTLE over a hundred years ago, the stagecoach, wagon, canal-boat, and sailing ship were the only means of transportation. Cities were dependent upon the surrounding countryside for food, and when they reached a certain size they had to stop growing, because food could not be found for more. Today every little village draws upon the entire world for its subsistence. The people of an Iowan hamlet eat wheat grown in Dakota, fruit from California, Louisiana rice, and Baltimore oysters; they wear shoes made in New England, clothing from Chicago, and use lumber cut in Washington. For most of this change we can thank the railroad, the great agency that has done more than any other single factor to make modern civilization possible.

RAILROADS. Today "iron horses" speed along steel tracks laid on every continent of the globe, drawing trains which carry people of every race and products of every land. They cross mountains, dash through forests, roar through tunnels, and pass safely over bridges that are monuments of engineering skill. Who invented these railroads? How are they operated? And what is their importance, that we spend so much money and energy in their building?

It is only a little over a century since the first of the "iron horses," or locomotives, came into existence. But long before that, a queer road of wooden rails laid end to end was built for horse-drawn wagons that hauled coal from mines in England. The tracks were raised above the level of the mud, fastened to the ground, and provided with flanges or ridges on the outer edges to prevent the wheels from slipping off the track, or "tramway." These were the first "rail" roads. Later the wooden rails were covered with strips of metal, the flanges were put on the wheels instead of on the track, and several loaded wagons were sometimes hauled by a single horse, linked together in a miniature train.

With the invention of the modern steam engine by James Watt, men began to study how to apply this new power to hauling on these tracks. A stationary engine was at first used, which stood at the end of the road and wound up a cable drawing the wagons along. The credit for inventing the first moving steam engine is given to Richard Trevithick, who in 1802 took out a patent for a steam "locomotive," but it was too imperfect for practical use. For a time it was believed that cog-wheels, fitting into cogs in the rails, would be necessary for drawing heavy loads, but before 1812 it had been proved that a locomotive with smooth wheels on smooth rails could draw heavy loads even up a moderate incline.

At this stage of progress, William Hedley invented (1813) a locomotive for use in the coal mines about Newcastle in England, which on account of its loud noise was called "Puffing Billy." George Stephenson, in 1814, brought out a locomotive which was used on a nine-mile tramway between a mine and its seaport, but it could not move a train much faster than a horse could walk. Then (in 1825) came Stephenson's engine, for the Stockton and Darlington Railway, in which the exhaust steam was sent up the chimney, causing a powerful draught in the firebox. This caused more rapid generation of steam and gave more power to the engine. Soon afterwards (1829) his engine, the "Rocket," made use of a multitubular boiler, and the essentials of the successful locomotive were complete (*see* Locomotive; Stephenson, George). The engines increased in size and improved in detail, but today's monsters of 300 to 500 tons are the big brothers of the old "Puffing Billies" and "Rockets."

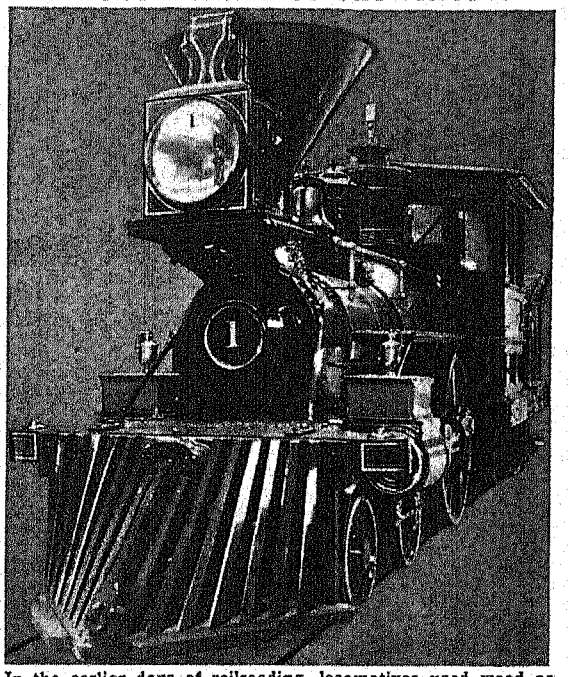
Meanwhile wooden railways, with cars drawn by horses or cables, had been introduced into the United States to carry heavy materials such as stone and bricks. One of the first was built in 1826 to haul stone for the Bunker Hill monument from quarries at Quincy, Mass., to tidewater.

The Stockton and Darlington Railway, in England, was the first line built for general traffic and it was the first to carry passenger coaches. The line from Liverpool to Manchester, for which Stephenson's "Rocket" was built, was formally opened in 1830. The Baltimore and Ohio, chartered in 1827, was the first steam railroad to begin operation for general traffic in the United States. In 1830 it tried out the tiny "Tom Thumb" locomotive (*see* Locomotive), but this was too small for practical use. The first successful American-built locomotive to be put in regular service was the "Best Friend" (1830) on the South Carolina Railroad. A few months after it started service, a Negro fireman held the safety valve shut, and the boiler exploded.

A hundred years later, railroads were found on every continent of the globe, with more than 245,000 miles in the United States, some 43,000 miles in Canada, more than 80,000 miles in the rest of the Americas, about 260,000 miles in Europe, more than 86,000 miles in Asia, about 45,000 miles in Africa, and about 28,000 miles in Australia. (The railroad mileage of the leading countries of the world will be found with the entry Railroads in the Fact-Index.) In normal times, United States railroads employ about 1,000,000 persons in the freight and passenger service. The trains carry almost one and a half billion tons of freight a year, and travel a distance equal to more than 30,000 trips around the earth.

In the United States, six so-called transcontinental lines, connecting the Pacific coast with the Missouri, Mississippi, or Chicago, have been built. The first was the Union Pacific, completed in 1869 from Omaha to Promontory, Utah, where it met the Central Pacific, built eastward from San Francisco. In 1883 the Northern Pacific, starting from St. Paul, reached Portland, and the following year the Southern Pacific linked New Orleans and San Francisco. Later lines were the Atchison, Topeka, and Santa Fe, from Chicago to San Diego, and the Great Northern, from St. Paul to Seattle, each completed in 1893, while the Chicago, Milwaukee, St. Paul, and Pacific reached Seattle from Chicago in 1909, virtually completing the main railroad net of the United States.

A WOOD-BURNER OF THE SIXTIES



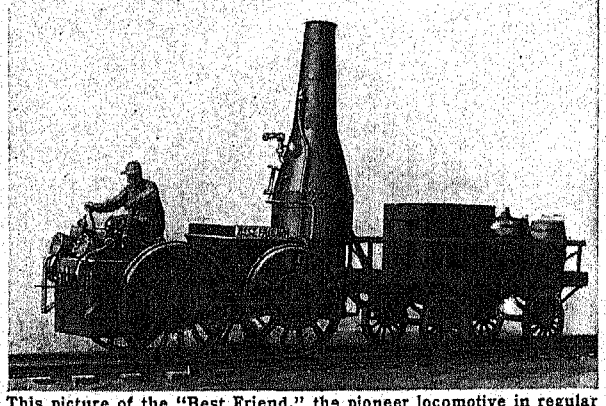
In the earlier days of railroading, locomotives used wood as fuel. This "wood-burner" is typical of those built about 1860.

Canada has two truly transcontinental systems. The privately owned one is the Canadian Pacific, with Atlantic terminals at Saint John, New Brunswick, Quebec, and Montreal. It was open to the Pacific at Vancouver in 1886. The government-owned Canadian National operates from the Maritime Provinces through Montreal to Pacific terminals at Prince Rupert (opened in 1914) and Vancouver.

The Soviet government's 6,287-mile railway from Leningrad to Vladivostok is the world's longest transcontinental line. The part between Chelyabinsk and Vladivostok, properly called the Trans-Siberian Railway, measures 3,886 miles, somewhat more than its original length, because it was rerouted after the seizure of Manchuria by Japan.

This development has transformed life. In the United States, before the coming of railroads, communication between the sections was slow and dangerous. As a result sections were developing separate interests, such as were revealed in the Civil War. The Pacific coast had little in com-

AMERICA'S FIRST SUCCESSFUL LOCOMOTIVE

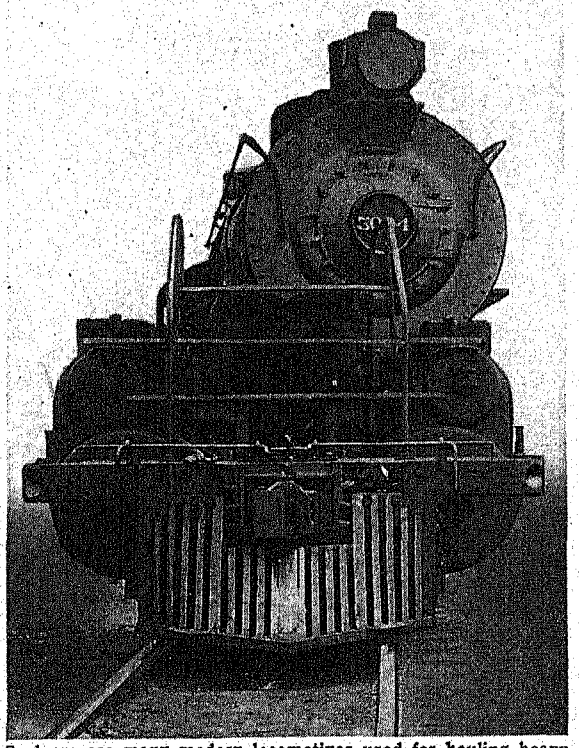


This picture of the "Best Friend," the pioneer locomotive in regular American service, is taken from a duplicate built and run to celebrate the hundredth anniversary of the engine's success.

mon with the eastern states. But the iron bands of the railroad have reached out east and west, north and south, binding the states into a nation "one and indivisible," and now the Pacific and Atlantic are as close together, measured by the time required for communication and travel, as were Boston and New York in the old stagecoach days. So, too, in Canada, which could never have been successfully united into one Dominion without the railroad to bind together the eastern, central, and western provinces.

The story of railroad building is as fascinating a subject as any in the long record of human progress. In building a railroad, the first work is the preliminary survey, or "reconnaissance." In the American Far West, the problem always was to find the best route to use over the Rockies, and the reconnaissance parties had many thrilling adventures with hostile Indians and the perils of mountain, forest, and desert. At the present time most of the country has been mapped by the government, so that the preliminary work of the reconnaissance surveys is often unnecessary.

THE LARGEST LOCOMOTIVES HAVE JOINTS



So large are many modern locomotives used for hauling heavy freight trains over mountains, that they could not round some of the sharp curves if they were not "jointed." The joint consists of a bearing on the front running gear, which permits the wheels to slide from side to side under the boiler.

Usually several routes are studied, and rough maps and profiles showing the features of each one are prepared. Experts then choose the best route; the choice they make has much to do with the success or failure of the new road.

One route may be fairly level, requiring only a few "cuts" through hills and "fills" over valleys. But it may require a tremendous tunnel to get under an intervening mountain, or several expensive bridges, which will make it more costly in the end than one with moderate "cuts" and "fills" all the way. Another route, though less expensive to build, may run through unsettled country. Hence it may be wiser to build the more expensive line, for the sake of the greater local business it can get.

This route selected is then surveyed carefully and building commences. Sometimes parties begin at each end and work toward the middle, in order that the completed track may be used to supply the workmen. Nowadays parties can be stationed at various points particularly where there are hard jobs, such as tunneling, and are supplied from other railroads already built near by. This method gets the road finished and earning money much more quickly.

The first work is the preparation of the road-bed. Following the stakes and plans prepared by the surveyors, the working parties clear away trees, make "cuts" and "fills," and otherwise prepare the way. Other parties set up bridges and dig tunnels.

As fast as the road-bed is ready, the track is laid, either by hand or by ingenious machines which feed the ties out on a belt, and put the rails in position. Working on level ground, track-layers can complete several miles in a day. Then the track must be ballasted, preferably with gravel, cinders, or stone, and then "seasoned," or shaken down.

In America the usual practice is to build a single-track line with as few tunnels, bridges, and expensive cuts and fills as possible, and start earning money. Then as the railroad prospers, "short cuts," called "air-lines," are made to eliminate sections of winding track which were built to avoid tunneling or grading. Then the track is doubled, first at portions where most trains pass, and finally over the entire route, and thus the railroad "grows up" into a first class line. This method is largely responsible for the great development of railroads in America, because it enabled companies to build roads in comparative wildernesses and make them pay. The railroad built up the community, and the community, by the business it afforded, in turn enabled the railroad to improve itself. Under the European practice of building an expensive line at the outset, and building only in settled districts, vast portions of the American West would still be wilderness today.

The Rails and the Rolling Stock

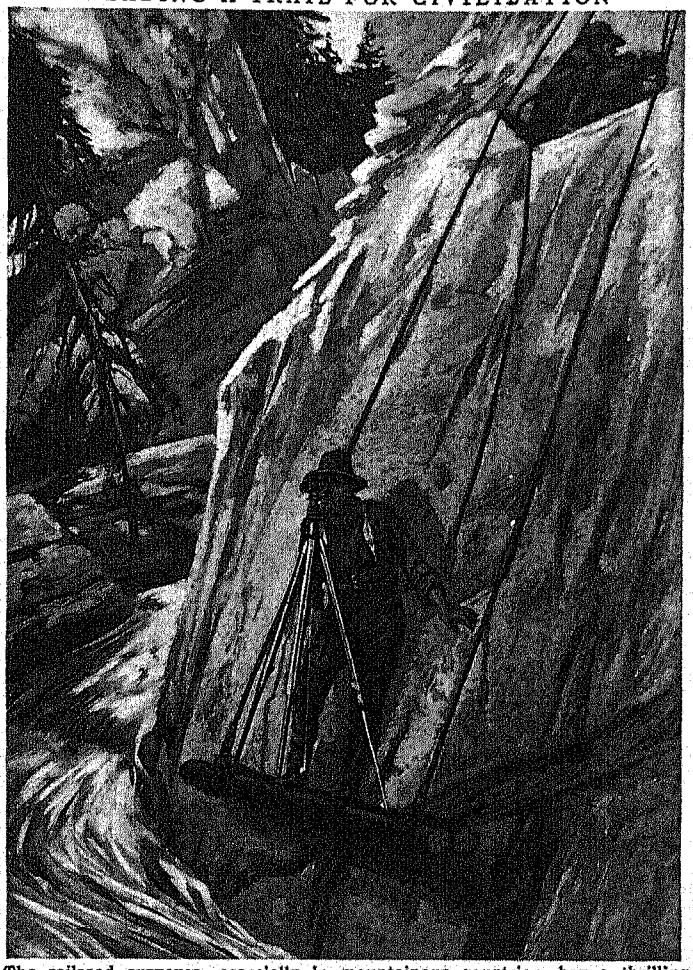
The rails are as important as the locomotive in the advance of railway transportation. A great improvement was made about 1820 by the substitution of tough wrought-iron rails for the perishable wooden or brittle cast-iron rails hitherto used. Steel rails are now used exclusively, and the rapid and enormous

expansion of railways after 1865 was largely due to the Bessemer process (*see* Iron and Steel), which made it possible to produce great quantities of steel rails easily and cheaply. The rail used universally in America for steam railways is known as the flanged T-section, and was invented in 1830. It is made in 39-foot lengths weighing from 80 to 130 pounds per yard, or for special roads, even as much as 150 pounds.

The "gauge" of the track is the distance between the rails of the two sides. "Standard gauge" for American, Canadian, and most European railways is 4 feet 8½ inches wide; this was the distance over all of the old wagon wheels. "Narrow gauge" (which may be as narrow as 2 feet 8½ inches) is used in America chiefly in mountainous regions. "Broad gauge" of varying widths beyond the standard has been used in different European countries.

All track must be kept "full spiked" and in perfect gauge to insure safety. Track is maintained by section gangs, a gang of four to seven men with a foreman having charge of a section of road—from five to eight miles of single track, and a proportionately shorter distance of double, three-track, or four-track road.

BLAZING A TRAIL FOR CIVILIZATION



The railroad surveyor, especially in mountainous countries, has a thrilling career. To him belongs the glory of the pioneer and explorer. In the early history of American railroads, as still today in Africa and other remote regions, he not only forced his way over stream and chasm but often had to fight savages and wild beasts.

There has been a similar improvement in the "rolling stock," by which is meant the coaches and cars for the transportation of persons and freight. The earliest passenger cars were built like four-wheel stagecoaches, and early freight cars like four-wheel wagons. About 1835 long-bodied cars mounted on four-wheel or six-wheel swiveling trucks began to be built, and this type is universally used in the United States and Canada today. It is economical to operate, because the proportion of car weight to load carried decreases as the latter increases. Commonly used types include mail, express, and baggage cars, dining, chair, and lounge or club cars, and various types of sleeping, or Pullman cars. Some of the latter contain an observation platform and lounge at one end, and the Pullman Company also furnishes parlor cars, with single seats. Roller bearings for the wheels are becoming common.

An American passenger car is entered at the end and is traversed by a center aisle, while European cars are divided into compartments and usually entered by a number of doors in the side. American day cars or coaches are from 65 to 80 feet long, and seat from 60 to 90 passengers each. Chair cars will not seat quite so many in the same space. The American Pullman sleeping car is 84 feet long. The standard car has 16 sections, with two berths to a section. Some have 12 sections, with a compartment and a drawing room; still others have compartments only. Most of these use the standard seat, convertible into a berth at night, but some cars on overnight runs carry a bed in each compartment. United States railroads rent sleeping and parlor cars from the Pullman Company, and the extra charges are divided according to government and contract regulations. Canadian roads own and operate their equipment. Dining cars are operated by the company or by private contractors.

Passenger cars are heated by steam from the engine and lighted either by electricity generated and stored while the train is in motion, or else by the Pintsch system of gas lighting. Some are air-cooled, the air being washed by water and cooled by refrigeration before passing into the cars.

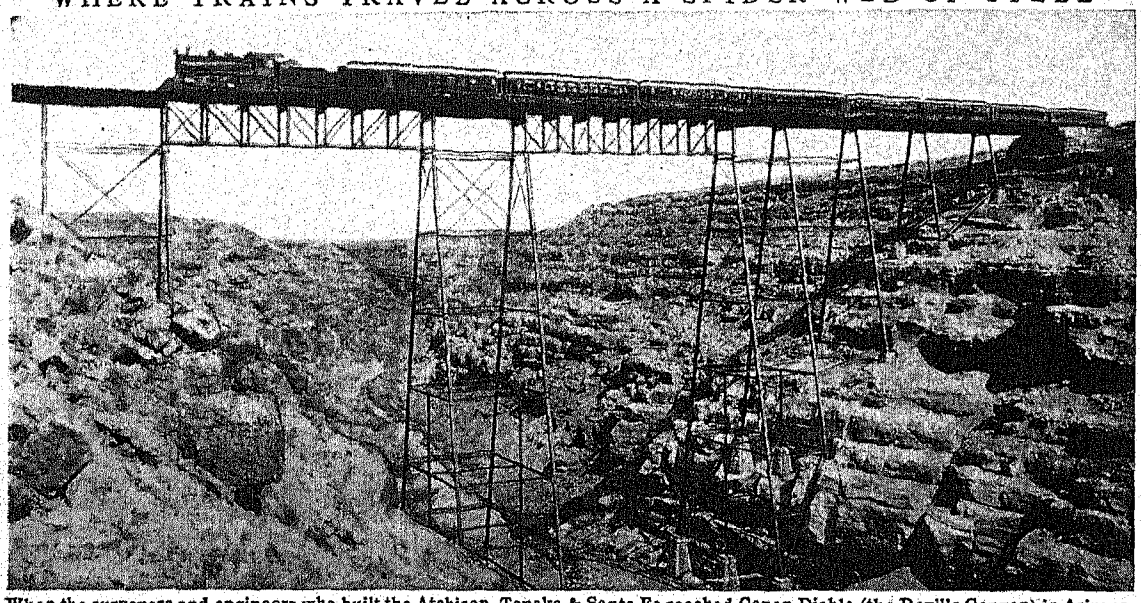
The ordinary American freight car is from 40 to 48 feet long, and few are of less than 30 tons' capacity; but European freight cars are much smaller. Cars have been constructed for different classes of freight, and an American freight train is often made up of flat cars, box cars, coal cars, gondola cars, hopper cars, tank cars, and (for perishable freight) refrigerator or heated cars. The caboose is the car in which the freight train crew rides. Steel cars are now taking the place of wooden cars for both passengers and freight because they are more durable and offer better protection against fire and wreckage.

The first railroad cars were held together by link chains and coupling pins. Later these were replaced by single iron links, held by large pins to sockets in each car. This device caused much jumping and swaying, and switchmen were constantly being killed while between cars coupling them. In 1887 the "M.C.B." (Master Car Builders' Association) adopted the coupler previously invented by E. H. Janney. This has a movable, claw-shaped end, which interlocked with the claw on any other coupler, both being held locked by pins dropping into place. To uncouple, the trainman could raise either pin by turning a handle at the side of the car. When use of his coupler was made compulsory by law, Janney generously threw open his patent rights to manufacturers. The airbrake, also made compulsory by law, further reduced danger in train operation (*see* Brakes).

Besides its track and rolling stock, a railroad needs a tremendous amount of "fixed equipment," such as passenger and freight stations, shops, and perhaps ferries, lighters, and tugs. Many terminals are huge buildings (sometimes union stations serving several roads), and offer almost every convenience to their patrons. Examples are the Union Stations in Chicago, Kansas City, and Washington, and the two largest railroad stations in the United States, the Grand Central and the Pennsylvania in New York City. The Grand Central is the largest railroad terminal in the world. It has two levels, containing about 79 acres of space, with 49 tracks, and cost $150,000,000. The Pennsylvania is the next largest, with 28 acres and 21 tracks. Both the Grand Central and the Pennsylvania have the usual railroad, express, and telegraph offices, telephone booths, restaurants, restrooms, news-stands, etc., and in addition hospitals for travelers suddenly taken ill, shops where they may supply almost any need, and rooms set apart for funeral parties obliged to wait for trains. The Grand Central Station even has private dressing rooms where travelers may prepare for evening parties or the theater, with valet or maid service, if they so desire. Over 500 trains a day arrive at and leave this station, and 750 at the Pennsylvania. The South Station in Boston has about 725 trains in and out daily, and the great station in Melbourne, Australia, is said to have an average of 1,600 daily.

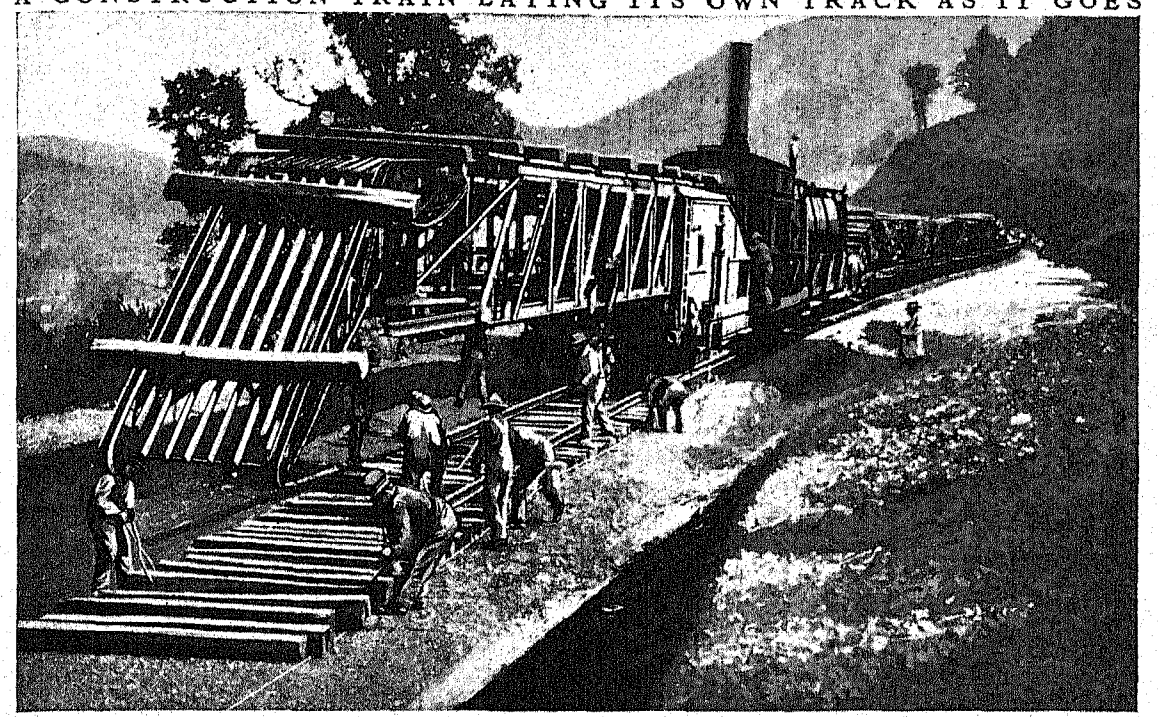
Coal and water must be provided at suitable intervals along the road. The fuel stations ordinarily are provided with coal in elevated bins or pockets, from which it can be dumped into the locomotive tender through a chute or hinged spout. To avoid the necessity of stopping a fast passenger express train to take water, some roads have built "track tanks" from which a locomotive can scoop up water

WHERE TRAINS TRAVEL ACROSS A SPIDER-WEB OF STEEL



When the surveyors and engineers who built the Atchison, Topeka & Santa Fe reached Canon Diablo (the Devil's Canyon) in Arizona, they were confronted by a terrible gash in the surface of the plateau. The canyon is 550 feet wide and 225 feet deep, and so many miles long that there was no chance of going around it. The only way to outwit the "devil" was to jump over his lair. So the engineers built this spider-like bridge of steel, over which great trains travel day after day.

A CONSTRUCTION TRAIN LAYING ITS OWN TRACK AS IT GOES



The first step in laying a track by machine is to bolt together enough rails in two continuous strings to reach from the flat-car at the rear on which they are piled to the pioneer car or engine. This double string is pulled steadily forward by compression rollers in the engine, passing through a space left beneath the ties on the other flat-cars. As the rails pass from the flat-car nearest the engine, ties are laid upon them at regular intervals. When they reach that bridge-like structure in front of the engine, the ties are picked up by endless chains and passed over the top, finally sliding off to the roadbed, where men place them in position. Meanwhile the rails slide forward, as you see them in the lower part of the bridge-like extension. As fast as they come out they are unbolted, ready to be lowered upon the ties when a proper position has been reached. The final spiking is done after the entire train has passed on.

while going at a rate of 30 to 40 miles an hour. A track tank is a pan 4 to 7 inches deep, 20 to 24 inches wide, and 1,200 to 1,500 feet long, and supplied with steam and circulating pipes to prevent freezing. The locomotive tender is provided with a hinged pipe which terminates in a scoop at one end and an elbow discharging into the tender tank at the other. As the train flies over the track tank, the scoop end of the pipe is lowered into the pan and the speed of the train forces the water up through the pipe into the tender tank. Oil is used for fuel in the Southwest.

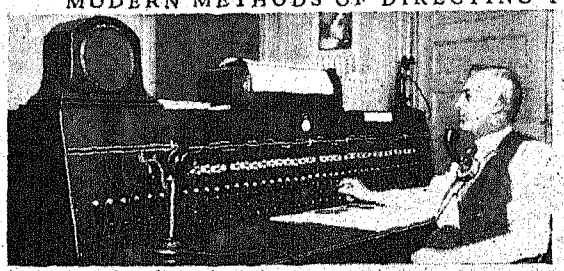
Repair shops are also necessary. A road of fewer than 800 miles will ordinarily have one general repair shop, with shops for light and running repairs at division terminals (a division is a section of the road, and may be as short as 150 miles or as long as 650 miles), if the road is a busy one. Many railroads have construction shops as well, where they build at least part of their rolling stock.

The engine house, to which an engine goes to be inspected and cleaned and given light repairs if not at once sent out again at the end of a run, is usually, on American roads, of the "roundhouse" type. The roundhouse wall is built on the segment of a circle. The approach track from the yards leads up to a turntable in the opening of the segment. Radiating from the turntable and ending against the circular wall are a number of tracks (called "stalls") upon any one of which a locomotive can be shunted by means of the turntable.

Ferry services are of much importance on some roads. Where bridges or tunnels are impracticable, car-transfer boats may be used to convey cars across streams or lakes. The Southern Pacific Railway operates on San Francisco Bay a car ferryboat with four tracks and a capacity of two locomotives and 36 freight cars or 24 passenger cars. A car ferryboat operating over a distance of 56 miles on Lake Ontario (from Rochester, N. Y., to Cobourg, Ontario) can transport thirty 50-ton coal cars at once. A still longer car ferry route (63 miles) is that across Lake Michigan from Frankfort, Mich., to Kewaunee, Wis. The boats are icebreakers, capable of breaking their way through a foot or more of ice. For transfer from one railroad to another between New York City, Hoboken, and Jersey City, or to loading piers, freight trains are broken up into short sections and carried on flatboats towed by tugs. Large ocean-going ferries carry freight cars between Havana, Cuba, and various United States ports.

Besides all the equipment necessary for the operation of a steam railway, several of the great lines of the United States have also installed elaborate electrical equipment on part of their systems, where it

MODERN METHODS OF DIRECTING TRAIN MOVEMENTS



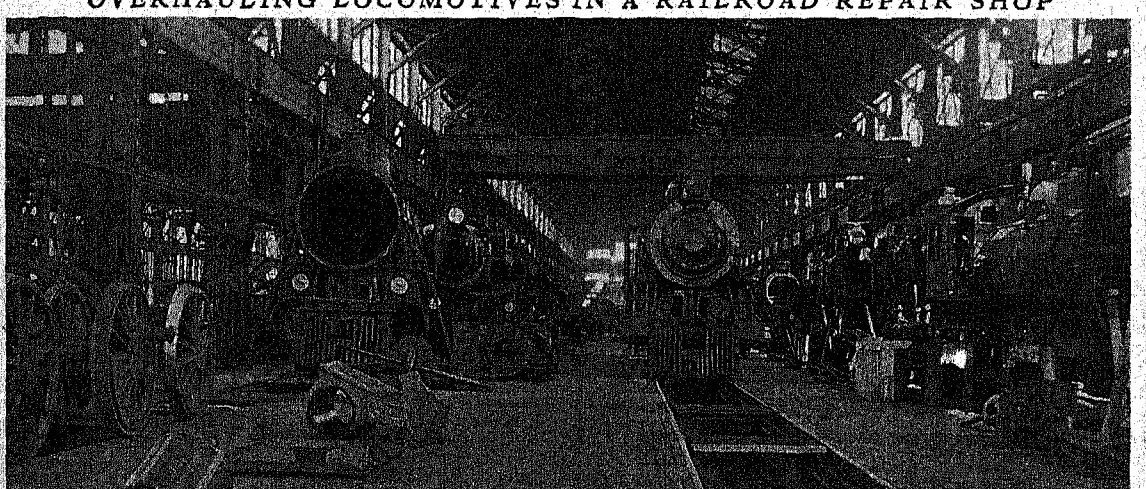
Above is the dispatcher seated at his control board. By means of the centralized traffic control system he is able to do all the switching and signaling of an entire section. To the right is a view of an up-to-date freight classification yard, where there is no need nowadays for an army of brakemen and switchmen. The cars are switched and brought to a halt with special "rail brakes" just as needed by a man sitting in one of those towers.

had been found desirable to do away with the steam locomotive. This has been done chiefly in terminal and suburban service in and about New York and in the operation of trains through tunnels, with the aim of eliminating smoke and noise and adding to the comfort of travel. In the electrification of the Chicago, Milwaukee, St. Paul and Pacific across the continental divide in Montana and Idaho, the main purpose was efficiency in operation, because the giant electric locomotives, 113 feet long, are each capable of doing the work of four steam locomotives. They can keep up almost double the speed of steam locomotives on heavy grades, and their efficiency is greatest in winter weather, when steam locomotives have their greatest troubles. These electric locomotives operate on the same principle as the small motors used on electric street and elevated railways (*see* Electric Motor; Street Railways). With the anti-smoke campaigns being waged in the great cities, steam is being replaced more and more by electric power or by oil-burning engines driven by Diesel or Diesel-electric motors. The electric locomotive also permits regenerative braking, that is, on down grades the motors act as generators and return to the power lines 30 to 35 per cent of the current needed to pull a train upgrade. Some railroads use a "rail-bus" on feeder lines. This is a gasoline-operated car of bus type which is capable of 78 miles per hour. This bus may be mounted on pneumatic rubber tires, with a steel flange to hold it to the rails, to make it ride more smoothly.

Controlling Train Movements

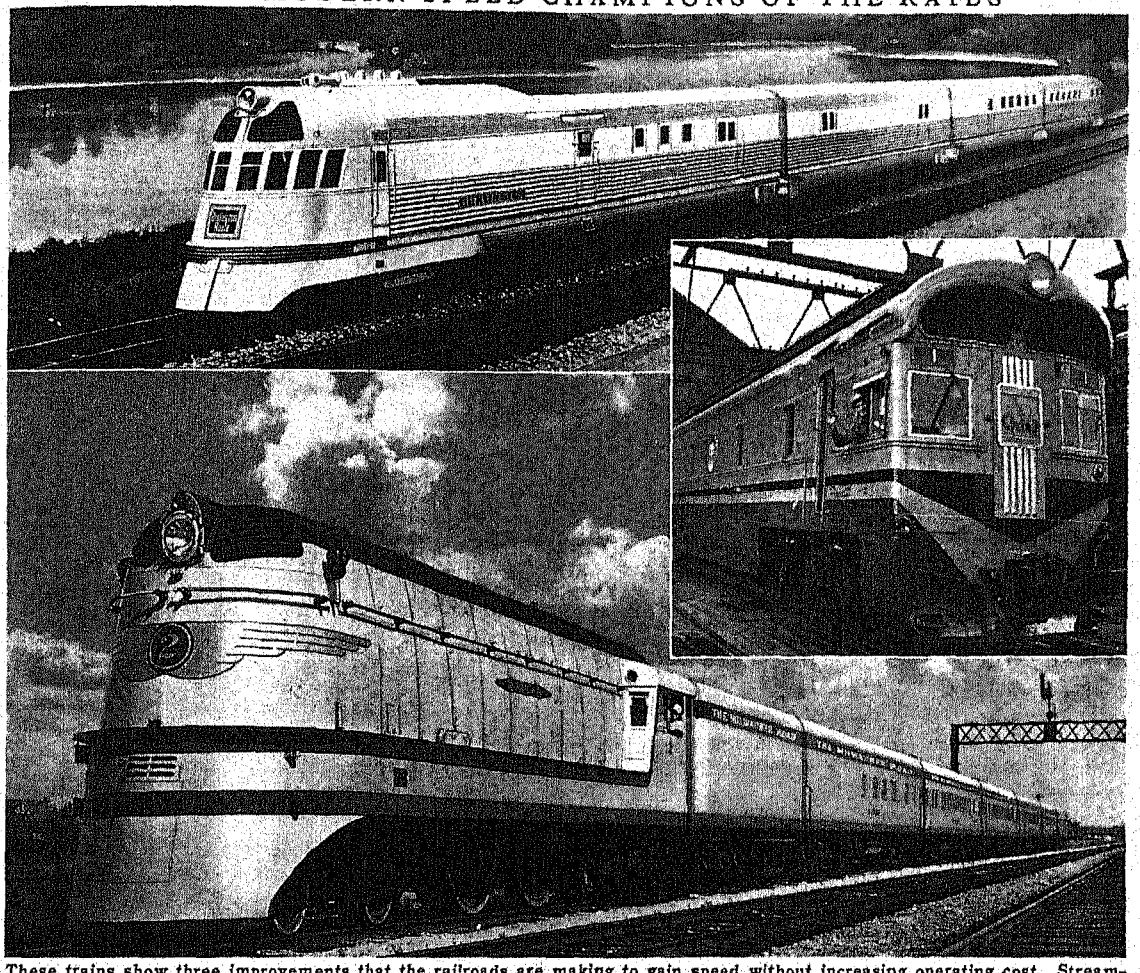
With the running of many trains over a system, operation becomes very complicated. There is danger of a fast train overtaking a slower train, as well as danger from collision of trains going in opposite directions. Parallel tracks with switchovers and passing tracks are built beside the main line so that trains going in opposite directions may pass, and also to permit a train to run around a slow train going in the same direction. The basis of operation is the train schedule, which shows the exact time each train

OVERHAULING LOCOMOTIVES IN A RAILROAD REPAIR SHOP



Railroad engines must frequently be overhauled and repaired to keep them in good condition. Light repairs are made at the divisional engine houses, but heavy repairs are made in such main shop plants as this. Notice the overhead traveling crane that can lift an entire engine off its wheels. The pits between the tracks enable workmen to get under the engines.

THREE MODERN SPEED CHAMPIONS OF THE RAILS



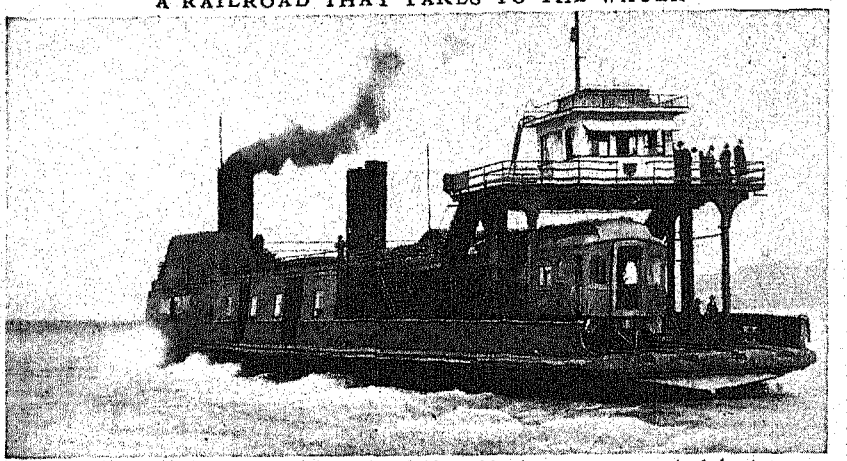
These trains show three improvements that the railroads are making to gain speed without increasing operating cost. Streamlining reduces air drag and cuts the amount of power needed. Replacing steam locomotives with Diesel-electric engines cuts the cost of providing power. Finally, use of alloys instead of steel reduces weight. The Burlington Zephyr at the top combines all three improvements, but at the expense of building all new rolling stock. The Santa Fe's Diesel-electric engine (right) and the Milwaukee's streamlined steam locomotive (bottom) give increased speed and economy even when hauling old-style cars.

is to leave the terminus and pass each station on the line. But more than this is necessary, for trains cannot operate exactly on schedule time. Delays may be caused by accidents, severe storms, icy rails, or snow drifts, and by many other causes. Freight trains will vary in their speed according to the weight of the load and the time required for loading and unloading at the various stations. It is also necessary at times to operate special trains.

The safety of a train in operation is largely in the hands of the train dispatcher—a man who sits at a table in the central office with a large train sheet spread out in front of him. On this is indicated the position of every train operating over the line. As the train leaves the station, the number of the cars, the names of the crew, the number of the locomotive, the time of leaving the terminal, and other significant facts are recorded on the sheet. As it passes each station the time is telephoned to the dispatcher, who thus knows the exact location of every train at any time. If delays or accidents make a change from the regular schedule necessary the dispatcher makes up the special orders for the trains affected and telephones or telegraphs them to the stations toward which the trains are running.

At grade crossings, diverging lines, and similar points, trains are protected by "interlocking plants." Attached to the signal and switch levers controlling movements on each line is a combination of locking bolts and bars. These locks make it impossible to give a "clear" or "proceed" signal to the line unless all the switches and signals are set against the other line. Thus it is impossible for a towerman to set switches and signals in such a way as to bring about a collision. As an additional precaution a "derailing switch" is provided, and a "clear" cannot be given one line unless the "derail" is set against any train which may try to cross on the other line.

A RAILROAD THAT TAKES TO THE WATER



In early days, before railroads could afford to bridge wide rivers, passengers took boats across, and boarded another train at the other side. Now the whole train may be taken across on a ferry, as in the case of this ferry plying between Detroit and Windsor, Canada. The ferry is double-ended, so that cars can be run on and off at either end.

At the busiest places, such as the Grand Central Station in New York City, still more elaborate control is necessary. At the Grand Central, suburban and express trains come in on different levels, and the trains on each level are controlled by electrical machines with hundreds of levers. Each lever operates a switch or signal. The machines are worked by a crew of men, each responsible for 40 levers; all work under a train director, who determines the track for each train to use.

The latest method of directing train movements is by the centralized traffic control system. The "passing-track" and other switches and signals are under the control of a dispatcher at a central point. An electric diagram shows the switch and signal settings, and the position of every train. With the controls on his machine, the dispatcher can sidetrack trains, direct one to use a passing track and get ahead of another, and control every movement.

How Block Signals Guard Trains

The greatest safeguard is the automatic block system. A "block" may be a mile or several miles long. So long as all switches are closed and no train is in the block, an electric current flows through the rails and the signal at the block entrance shows "clear." When a train enters the block, its wheels and axles short-circuit the current, and the signal changes to "stop." On many railroads, "automatic stops" halt a train if the engineer should run past a stop signal.

Another method uses a "continuous coded signal." The track current is alternating, and changes its frequency (*see* Electricity) whenever the signal ahead changes. Each frequency causes the corresponding signal to show on a "cab repeater" before the engineer. The repeater may act also as an automatic stop.

Thanks to all these unseen safeguards, accidents to passenger trains are rare. A busy four-track line may have three or four sections of a fast limited train speeding along, shifting from track to track to work around slower local trains and freights. The same track may be used, first in one direction, then the other, for "passing" movements of trains. Yet all this traffic moves safely, much of it at better than a mile a minute speed, with few accidents or delays.

Even though buses, airplanes, trucks, and private cars have cut down railroad business tremendously, American railroads still have a gigantic task to perform. Even in the worst of the recent "depression" years their passenger business amounted to carrying everyone in the United States 135 miles. Freight carried amounted to 1,878 tons moved a mile for every man, woman, and child in the country.

Moving freight is by far the bigger part of railroad work. Without freight trains the nation would be paralyzed in a few weeks. Hundreds of huge coal trucks and their hundreds of drivers could not haul the load taken by six or eight men on one freight train. A thousand trucks and drivers, and two weeks of time, would be needed to deliver one trainload of California fruit in New York. Moreover, railroads charge on the average for all shipments only about one cent to move a ton a mile. When all costs are considered, no other form of land transportation moves goods so cheaply.

Freight Yards and Trains

Freight is gathered in a variety of ways. Large shippers load cars set out on their sidetracks; small L.C.L. (less than carload) shipments are taken to freight houses. Here the packages are placed in the "New York car," the "Seattle car," or perhaps a car going to serve points on another railroad. The loaded cars then are taken to some central yard to be assembled or "classified" into trains.

When possible, big yards use the "gravity" or "hump" plan. Each incoming train comes to the edge of a downward slope; cars are cut off one by one, and roll down the slope on to the track set apart for the train which will take the car out. One "hump" may classify 2,500 cars or more a day. In "flat" yards, switch engines "drill" the cars into trains.

Large classification yards usually are to be found at important railway intersections to handle "interline" cars. Many large cities are circled by "belt" railways, connecting various lines, and transferring most of the cars not destined for the city itself.

Cars are classified not only by destination, but into "fast" and "slow" trains. Chicago's package shipments, for example, come to freight houses until almost evening. By eight o'clock fast freight trains

are starting for all important points in the country. Refrigerated shipments of meat and other perishables move even more swiftly. An example of fast railroad work is the train which carries shipments from Sioux City and Omaha to the East. Before stopping in the Chicago yard for transfer to another railway, this train drops its caboose. The connecting railway's engine comes in from a side track, attaches another caboose, then shoots ahead on a parallel track. The train stops just long enough for inspection of air-brakes and running gear. Meanwhile the waybills are stamped, and the new locomotive is attached. In less than ten minutes the train is speeding east.

The greatest speed of all was made in hauling Japanese silk that used to go across country to New Jersey. Sometimes a single shipment was valued at millions of dollars, and insurance on it was charged by the hour. So the fastest passenger trains were sidetracked if necessary to let the silk train speed through.

Holding Down "Tonnage Freight" Expense

The heavy or bulky commodities, such as iron ore, coal, and building materials, which make up most of our freight, must be moved at the lowest possible cost. These are carried as "drag" or "tonnage" freight at the most economical speed—usually about 20 miles an hour. In Ohio, for instance, you can see long tonnage trains hauling West Virginia and Pennsylvania coal to Lake Erie and bringing back iron ore.

Nevertheless, to "pay out" at low rates, fast work is needed. Mines cannot operate unless freight cars are at hand. But cars are expensive; so railroads keep the number of cars down and "turn around" each car for another load as rapidly as possible. One railroad spent millions of dollars to lengthen tracks in one yard so the "hump" could classify cars into 150-car trains, and millions more to build a new coal-and-ore port on Lake Erie, so that each train could unload its coal, take on iron ore, and be off again in a few hours.

Freight Rates and Regulation

Rates charged for freight vary even more than the service given. Difference in cost of handling explains part of the variation. It costs more to handle L.C.L. or package freight in freight houses and on fast merchandise trains than it does to haul coal on a tonnage train. But business considerations affect freight rates even more than cost.

To make up for the low rates on tonnage commodities, railroads must charge higher rates on other commodities. Rates, therefore, are arranged in "classes." The most valuable commodities, and those most difficult to handle, are "first class," and pay the highest rate. There may be a fifth class, or even a seventh class, rate for articles taking the lowest rates. "Commodity rates" are special rates for articles not "classed."

Railroads must also consider the competition which shippers along their lines encounter. If eastern railroads, for example, charged by the mile and the pound for carrying shoes, the shoe manufacturers of New England could not compete with those of St. Louis beyond the midway point between the two regions. To get more shoe shipments from New England, eastern railroads therefore give a low rate which will enable their shippers to sell shoes in territory near St. Louis. This is called "charging what the traffic will bear." This system gives manufacturers a nation-wide market, regardless of their location.

Fairly administered, such a rate system has many advantages. But during their earlier days many railroads juggled the rates to favor particular communities or shippers; so the United States government set up a regulating authority to insure just and impartial rates (*see* Interstate Commerce Commission).

Costs are often figured in terms of train miles, car miles, and ton miles. Passenger fares usually are arranged on a mileage basis. Express cars, mail cars, and the Pullman Company's sleeping and parlor cars are carried under terms of contracts arranged between the various parties. Passenger service furnishes only from one-tenth to one-seventh of American railroad income, but makes up nearly one-half of the total train mileage.

Railroad Problems of Today

For many years, the railroads had been feeling the effect of competition by passenger and freight motor vehicles and airplanes. The business depression which began in 1929 brought most railroads to a financial crisis. Many companies tried to recover business by improving their service. "Door to door" freight service was tried, including greater use of "L.C.L. containers." These are steel boxes picked up by trucks from shippers, carried on special railroad cars to destinations, and delivered by truck.

A spectacular development in passenger service was the high-speed, streamlined train. The Union Pacific was first to acquire such a train. An electric generator driven by a Diesel engine furnished current for the train's motors; use of alloys lightened weight; and streamlining reduced air drag. (For principles of streamlining, *see* Airplane.) Such a train, with eight cars, ran 1,017 miles from Denver to Chicago on the Burlington in 12 hours and 12½ minutes, or 83.3 miles an hour, terminal to terminal, at a fuel cost of $54.60. With the older trains, about 50 miles an hour, terminal to terminal, had been the highest speed on long runs, although portions of the run might be made at better than 70 miles an hour. A record three-mile run in 1905 was 127.1 miles an hour.

Another improvement widely adopted during this period was air conditioning of passenger cars. Air is drawn through a bath to clean it from dust and cinders and to provide correct humidity, and then is heated or cooled according to season, before it is admitted to the car. Windows and doors are kept sealed.

The Mighty Army That Runs the Road

What an army it would be if all the million people normally employed in railroad service could be gathered together! First would come the thousands responsible for track. Those who build engines and

railway cars would come next, with numerous companies of caretakers and repair men to keep them in working condition. The vast regiment of men in charge of the trains would make up the main body of the army—men trained to prompt and faithful service, alert and watchful over the lives and property in their keeping, and heroic and unhesitating in obedience to their orders. Here, too, would march the train dispatchers and the telegraph operators, while from the stations would come the station masters and train masters, with ticket agents, cashiers, and a host of typists and assistants. From the main offices would come the men who do the important work of purchasing the supplies, others who look after securing business for the road and distributing rolling stock where it is needed by the shippers, and the large organization needed to keep track of the expenses and revenues of the railroads. Truly a vast amount of money goes into the building and operating of the railroads—from 3 to 6 billion dollars a year in the United States alone—and a mighty host is busied with its ceaseless tasks.

RAINBOW. No doubt you have heard of the children who tried to find the end of a rainbow, because they thought that beneath the end they would find a pot of gold. They never found the end, because a rainbow is simply an effect created in the sky when the sun's rays are refracted by countless raindrops. Hence we see them when the sun begins to shine after a storm, but while the air is still filled with raindrops. We see them best when the sun is at our backs and rain still is falling in the distance ahead of us.

The colors are caused by refraction, as explained in the articles on Light and on Spectrum and Spectroscope. A raindrop separates sunlight into bands of colored light just as a prism does. The far surface of each drop reflects the bands back toward us, and they are bent or refracted again as they leave the drop. We see the portion which leaves each drop in the direction toward our eyes; the "bow" we see is curved, because the light comes from curved drops.

Such a bow, formed by one reflection within each raindrop, is called a primary rainbow, and has the red on its outside edge. Each drop, however, may reflect light back from the edge nearer us, to the farther edge. There it emerges and we see it showing faintly against distant clouds, outside the primary bow. Such a secondary bow will have the red on its inside edge.

We can also see rainbows in the spray given off by lawn sprinklers and waterfalls, when we stand at a proper angle and view sunlight striking through the spray. So-called "white rainbows" are haloes around the sun or the moon, which do not have the colors separated enough to show as distinct bands.

In bygone ages men were greatly perplexed by the rainbow, and invented fables to explain it. The ancient Greeks used to imagine that it was a sign placed in the heavens by the gods to foretell war or heavy rain. The slender golden-winged Iris was the goddess of the rainbow, who bore messages from the gods to men. The Norsemen believed that the rainbow was the bridge over which the gods passed from earth to their home in the sky.

RAINDROPS *that* WAKE *the* FIELDS *to* LIFE

RAINFALL. The richest land in the world is worth exactly nothing at all for agriculture without rainfall or irrigation—and irrigation depends upon rainfall for its original water supply. With few exceptions, the value of land for agriculture increases as the amount of rainfall received in a year increases.

In temperate climates, live stock thrives and abundant crops can be obtained without irrigation if the annual rainfall is 20 inches or more. This measurement means that if all the rain received during a year could be gathered together, it would cover the land to a depth of 20 inches or more. An annual rainfall of 10 inches may be enough, if it comes at the right time during the farming season. These figures are only rough averages, for many conditions such as high average temperatures or sharply sloping land make increased rainfall necessary. Rainfall the world around varies from 450 inches a year in Cherrapunji, India, to 0.3 inch at Walvis Bay in southwest Africa.

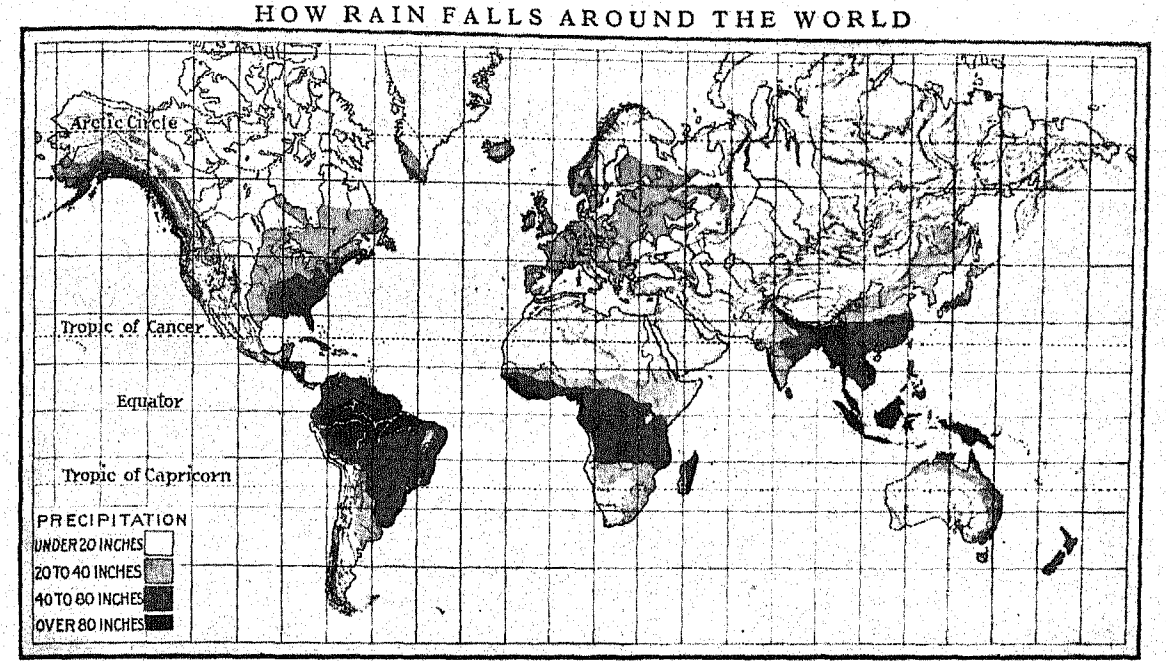
Where Does Rain Come From?

The sun is the father of rain. Heat from the sun evaporates water from the oceans, from lakes and rivers, from damp earth, and from the leaves of trees and plants. The moist vapor becomes mixed with the air, and stays mixed so long as the air remains at the same temperature. But if the air cools, the moisture condenses, first into clouds, then into raindrops (*see* Air; Clouds; Evaporation; Water).

A region receives rain, then, only when moist air above it becomes cooled. This may happen close to the place where evaporation made the air moist. During a hot summer day, rising air over a moist region may cause the formation of cumulus or "wool pack" clouds. These clouds darken to rain clouds as they acquire water vapor; when they cool in the afternoon, the moisture condenses to rain and causes a thunderstorm or thundershower (*see* Storms). North or south of the Equator, wherever the sun is overhead at a given season, such equatorial thundershowers occur constantly, and cause rainy hot calms called the *doldrums*. The East Indies, the Malay Peninsula, and the valleys of the Amazon and the Congo rivers, have a great deal of this kind of rain.

In contrast to such locally generated rainfall, much of the moisture received by many parts of the earth has been brought from distant oceans by the prevailing winds. Most of the rainfall over southeastern Asia, including India, China, and parts of Manchuria, and northeastern Africa, is brought by moist monsoon winds which blow steadily throughout the summer

HOW RAIN FALLS AROUND THE WORLD



You will notice that the regions of heaviest rainfall, over 80 inches a year, are all situated either in the neighborhood of the Equator or on the seaward side of great mountain ranges. The Amazon valley, the west coast of Africa, and the islands of the East Indies are in these regions of heaviest moisture, as is part of the Pacific Coast of North America. North and south of the Equator are drier regions, caused, as explained in the text, by the trade winds and descending air in the horse latitudes. Central and eastern North America and Europe receive rain from the cyclonic storms of the prevailing westerlies.

from the Indian and the Pacific oceans (*see* Winds). The moist air is cooled as it blows inward over rising land, and lets fall abundant rain.

In the belt of prevailing westerly winds which blow over most of North America and Europe, much of the rainfall is brought by cyclonic storms. These storms may be likened to great whirls of air, hundreds of miles across, which draw in moist air from their eastern and southern edges. Toward the center of the storm, the moist air is forced upward and cooled. This cooling gives rain to every region over which the center of the storm passes (*see* Weather Bureau). European Russia, Siberia, France, Hungary, and Argentina enjoy good rainfall from cyclonic storms.

High mountain ranges or plateaus usually force rain out of any moist winds that strike them, for they deflect the air up to cooler heights. Most of this rain falls on the slopes and mountain sides that face the wind; the other side beyond the crest receives little or no benefit from it. Southwestern Colorado, Tibet, Khorassan, and parts of Bolivia and Peru are dry plateaus for this reason. If a region does not provide some means of cooling the winds that blow over it, it cannot have any rain. This happens at certain seasons in the belts of the trade winds and in the horse latitudes. It is true the year round in the Sahara Desert, the deserts of Arabia, and along the coast of South America from 5° to 30° south latitude.

Rain Needed by Various Plants

Different plants require different amounts of moisture. Cotton and corn need a great deal. Hard wheat needs much less, and grows well west of the Missouri River where the moisture is insufficient for corn. Plants with deep tap-roots like alfalfa, which reach far underground for water, or plants with leathery surfaces that check evaporation, such as the cactus, need very little rainfall.

But plants do not necessarily thrive in a region which receives the minimum rainfall they require, unless the minimum falls during their growing season, and unless the local conditions tend to keep the moisture where it falls. Thus, the state of Chihuahua in Mexico receives moisture enough for almost any crop, but most of it comes in the summer and autumn. Evaporation is rapid in the clear, hot air; a hard clay subsoil prevents absorption into the ground; and, as a result, Chihuahua is largely a desert. High winds over a region increase the amount of rainfall needed by increasing the loss due to evaporation.

Rainfall Belts in the United States

The United States is divided into five belts of varying value for agriculture. These belts are shown by a map printed with the article on Drought; they are fixed largely by rainfall, although temperature, mountain ranges, and other factors are also important. We can explain their existence readily, once we understand the geography and weather of each region.

Most of the moisture in the United States is brought originally by the prevailing winds from the Pacific Ocean, the Gulf of Mexico, and to some extent from the Atlantic Ocean and the Great Lakes. These prevailing winds come from the west, and bring

cyclonic storms; but they are modified somewhat as far north as Ohio and as far west as Texas, Arkansas, and Missouri, by monsoon winds from the Gulf.

The west coasts of Alaska, British Columbia, Washington, Oregon, and northern California receive ample rain, as moisture-laden winds from the Pacific are forced upward by the Coast Ranges and the Sierra Nevadas. Southern and Lower California are dry, particularly in summer, because they feel the drying influence of the trade winds. In these latitudes the winds remain dry over Arizona and New Mexico. Over central Texas, cyclonic storms begin to receive moisture from the Gulf of Mexico, and monsoon winds also bring moisture from the Gulf. In the mountainous parts of the West, the winds can obtain some moisture from melting snows and mountain lakes, and precipitate it upon near-by highlands.

East of the Rocky Mountains, the rainfall increases as the cyclonic storms draw in moisture from the Gulf of Mexico, the Great Lakes, and the Atlantic Ocean. The supply of moisture from the Gulf is the most reliable; hence the country north to the Ohio River always has abundant rainfall. Likewise the regions immediately west of the Great Lakes and along the Atlantic never suffer seriously from lack of rain; but an occasional deficiency is found between these two areas, from Iowa to Ohio. Viewed as a whole, the United States can be roughly divided at the 100th meridian into an eastern portion of good rainfall, and a western portion of variably good and bad rainfall. This meridian runs approximately down the middle of North and South Dakota, Nebraska, Kansas, Oklahoma, and Texas.

Measuring Rainfall

Rainfall may be measured by catching it in any flat-bottomed vessel with perpendicular sides, placed exactly level where it will receive the full force of the rain. The depth should be gauged with a very thin ruler—a thick one would raise the water level. As it is difficult to measure small amounts accurately, a special rain gauge has been devised, with a funnel and an inner can so proportioned that each inch of water in it stands for one-tenth of an inch actual rainfall.

Raisins. Raisins really are small, extremely sweet grapes, carefully dried in the sun. Only a few regions in the world can produce them, because when the grapes are ripe, the grower must have many weeks of hot, rainless weather in which the grapes can dry.

Regions adjoining the Mediterranean, particularly the Spanish provinces of Malaga, Alicante, and Valencia, parts of Greece, and Asia Minor near Smyrna, have the required climate (*see* Climate); so do parts of southern Australia. The San Joaquin and Sacramento valleys of California are ideal for raisin culture, and lead the world in production. The drying season, from August to November, is hot and rainless, while the near-by mountains provide water for irrigation during the growing season.

In California, the grapes ripen in August. They are cut from the vines and allowed to lie in trays between the rows for from 2 to 3 weeks. A further period of drying in boxes follows. Then they are taken to the packing plant, where endless-belt conveyors carry them through the processes which prepare them for market. Special machinery removes stems and dirt; the grapes then are washed, steamed or soaked in special solutions, dried, inspected, and packed. About three-fourths of the original weight of the grapes is lost in drying.

The largest raisins are produced from Malaga or Muscatel grapes. Sultana seedless raisins are a small variety, grown only near Smyrna; the California seedless raisins are from a grape known as Thompson's seedless, or Sultanina. (*See also* Currants; Grapes.)

MANY-SIDED RALEIGH *and His* VISIONS

Raleigh (*rą'lē*), **Sir Walter** (1552–1618). Politician, soldier, sailor, explorer, poet, and historian, this popular hero stands out as an illustrious example of the many-sided genius of the men of Queen Elizabeth's time, and of the stirring and adventurous life of the day. But his greatest title to fame rests on his efforts to colonize the New World. Even in an age that abounded in keen intellects and bold imaginations, Raleigh shone because of his brilliant mind and daring imagination. To him came the vision of a new England beyond the seas, and the irresistible appeal of this dream clung to him all his life. Through many years of failure and disappointment he strove to fulfill this vision.

Born at Hayes, Devonshire, in 1552, Raleigh entered Oriel College, Oxford, in 1568, but left the next year to fight on the side of the Huguenots in France. In 1580 he distinguished himself in the suppression of the Irish rebellion in Cork, and soon afterward was introduced at court and became a favorite of Queen Elizabeth. You remember the story of how he won the Queen's favor by throwing his costly velvet cloak on a muddy spot to enable her to walk over it dry-shod.

Raleigh's tall and handsome figure, his dark hair, lofty forehead, resolute bearing, courtly manners, and spirited wit combined to form an imposing personality; and all the advantages that nature had given him were heightened by a gorgeous splendor in dress and jewels. But he was proud, haughty, and impatient, and so made hosts of enemies and was never fully admitted to the Queen's counsels in matters of state. The playful name of "Water" which she applied to him would indicate that she recognized the instability of character which was his great fault and which in the end worked his ruin. Elizabeth, however, lavished numerous favors upon him throughout her reign, and he discharged with conspicuous ability the responsibilities of several important positions to which she appointed him.

RALEIGH IS CHARMED BY 'THE FAERIE QUEENE'

In 1588 or 1589, while in Ireland, Raleigh made the acquaintance of the poet Edmund Spenser. The artist has pictured a scene in Spenser's castle, when the poet is reading to the courtier his great poem, 'The Faerie Queene'. So delighted with the work was Raleigh that he used his influence at court to obtain a pension for Spenser and also obtained financial help from Queen Elizabeth for the publication of the poem.

Even before Raleigh appeared at court he had been interested with his half-brother, Sir Humphrey Gilbert, in a colonizing venture to Newfoundland. Up to that time England did not own a foot of land in America. Raleigh's new position at court gave him increased wealth and opportunity to push his great project, although the queen would not let him lead any of his colonizing expeditions in person. Raleigh was tireless in his efforts to plant "our people in America," and sent out expedition after expedition. The name of "Virginia," honoring the "Virgin Queen," given to the area explored by one of his expeditions (1584) alone remains to testify to his efforts, for none of his colonies survived. (For the story of the Lost Colony of Roanoke, *see* North Carolina.) Nevertheless the pioneer work of Raleigh paved the way for the later colonists who were successful. Curiously enough, too, by making the smoking of tobacco popular he helped create a demand for the plant by the culture of which the colonists later found a sure road to wealth.

Raleigh was in Ireland when the Spanish Armada (1588) appeared in English waters, but he hastened to England and as vice-admiral of Devon he had his share in the work of that exciting time (*see* Armada). In the years which followed he took part in various expeditions against the Spaniards. In 1595 he sailed at the head of an expedition to Guiana, in search of the fabled El Dorado, and on his return empty-handed, after much hardship and suffering, he wrote 'The Discoverie of Guiana', one of the most fascinating of Elizabethan narratives of adventure. Next year (1596), Raleigh sailed in the expedition under Howard and Essex to Cadiz, and although he was seriously wounded, it was his counsels that governed the whole plan of action which for a second time shattered the naval power of Spain.

Raleigh's popularity at court had been waning since his marriage to one of Elizabeth's maids of honor, which enraged the jealous queen. With the accession of James I (1603) complete disaster overtook him. The Scottish king suspected that Raleigh had worked against his becoming king of England, so he stripped Raleigh of his numerous offices and privileges. In anger Raleigh then took some part in one of several plots of the time, and was arrested and tried on a charge of conspiring against the king's life. Although no satisfactory evidence could be produced, Raleigh was condemned to death and only on the scaffold was his sentence commuted to imprisonment for life. His admirable bearing during the trial turned public opinion in his favor. One of his enemies said: "When the trial began I would have gone a thousand miles to see Raleigh hanged; before the trial closed I would have gone a thousand miles to save his life."

The next 13 years Raleigh spent in the Tower of London, where he was visited by many of the great scholars and poets of the day. Most of the time his wife and son were permitted to live with him. During this period he worked on a 'History of the World' for King James's son, Prince Henry, whose favor he enjoyed. Three volumes of this work, down to 130 B.C., were finished and, when published, were widely read. Raleigh also had written verses of good quality, and a good deal in the way of political philosophy.

RAPHAEL SANTI
Most Beloved of All Painters

Raleigh finally persuaded the king to release him in 1617, on condition of leading an expedition to the Orinoco River and bringing back some of the gold from a mine he said he had discovered on his previous expedition. He pledged himself not to come into collision with Spain, though this evidently was an impossibility; some of his men, while he was sick aboard his ship, attacked a Spanish village and burned it to the ground. Raleigh returned to England without finding the mine, to face the enraged protests of Spain. King James basely re-arrested him and had him executed (1618) under his old sentence, which had never been revoked. Cheerful and resolute to the last, when Raleigh was led to the scaffold he asked to see the ax, and, touching the edge, said: "This is a sharp medicine, but it is a sure cure for all diseases." Thus died the man who gave the first great impulse to the movement of English colonization which produced the United States.

RAPHAEL (*răf'ā-ĕl*) **SANTI** (1483–1520). "Let him be my pupil; he will soon become my master," said the Italian painter Perugino, when he saw the work of the boy Raphael. He spoke the truth, for Raphael became the master painter of his time and even today is the most generally praised, and certainly the most beloved, of all the painters of the world.

"He is an innocent angel," Pope Julius II exclaimed as the beautiful Raphael, his chestnut locks falling upon his shoulders, knelt before him. This was when Raphael, 25 years of age, was beginning the most important work of his life, the execution of those numerous wall paintings which still decorate the halls and chambers of the Vatican or palace of the pope in Rome. Vasari, who tells us so many stories of the lives of these old-time artists, says of Raphael and his numerous assistants, at this time: "He was never seen to go to court but surrounded as he left his house by some 50 painters, all men of ability and distinction, who thus attended him to give evidence of the honor in which they held him. Among them there was no rivalry or jealousy, for all became of one mind, once they began to labor in the society of Raphael, every vile and base thought departing from the mind before his influence." To all of these pupils Raphael was as a father.

But though princes considered themselves favored if this young artist even designed a picture for them, and though his students and assistants bowed before him as before their sovereign, Raphael always thought of himself as a pupil learning from the works of others how to make his own art more perfect. From his boyhood days in the studio of his father in Urbino, on through the years with Perugino, the wonderful days in Florence with Leonardo da Vinci and Michelangelo, in Rome at the height of his powers—everywhere he found some point which he could use. In part it was this purity and fineness of his spirit that have made his work immortal. His maxim was, "We must not represent things as they are, but as they should be." So whether he painted an altar-piece for a church, a great fresco of Bible history or classical mythology, or made a pattern cartoon for a tapestry, the picture was sure to be beautiful. How completely he succeeded in this is shown, for example, in his picture entitled 'The School of Athens', which is only one of four great wall paintings with which he beautified a single one of the pope's rooms in the Vatican.

Raphael also painted more than a hundred pictures of the 'Madonna', or Virgin Mary. Do you know the one called the 'Madonna of the Chair'? It is told that passing along the street one day Raphael saw an Italian mother in the picturesque costume of the Roman people, with her baby in her arms. He was struck by the picture she made sitting there before her doorway, and seizing the cover of a wine cask near by, he made on it a pencil sketch for this famous painting. His 'Sistine Madonna' (so called because it was painted for an Italian church dedicated to Saint Sixtus, but which is now in the Dresden Gallery) is one of the greatest pictures in the world. When the great painter Correggio stood before it he exclaimed with pride, "I too am an artist!" But others besides artists are affected by this painting. Crossing the threshold into the room where it stands alone, amid hangings of black velvet, the most frivolous become touched with awe.

Raphael died at the early age of 37, yet he left an amazing amount of work. The wall paintings which he designed for the Vatican alone might have been the work of a lifetime, but besides these there are hundreds of pictures and studies. And throughout all, there is not an expression of the face or a drapery which is not exactly suited to its purpose, nor in the thousands of figures which he drew is there an ungraceful line or pose. Other artists have drawn well, others have equally mastered color, others have shown greater power and grandeur in conception; but none before or since has shown such surpassing skill in picturing the ideal, the spiritual, the beautiful, as Raphael of Urbino.

He is one of the three great painters in whom the Renaissance flowered. His last days were devoted to his famous painting, 'The Transfiguration', but before he could complete it, death ended his work.

To fully appreciate Raphael's work one must visit Rome; but many galleries elsewhere in Europe contain examples of his art, and a few of his paintings are in the United States. The Metropolitan Museum of New York City owns an early Madonna. The beautiful 'Madonna of the House of Alba' and 'St. George and the Dragon', which Andrew Mellon bought from the Hermitage Gallery in Leningrad, are in the National Gallery of Art at Washington, D. C.

RASPBERRY. The raspberries in the fruit gardens of today are the cultivated descendants of the wild briar patch or "bramble tangle." A great many different varieties have been developed and improved from both European and American wild species.

The "black cap" or black raspberry is a native of America, as is also the most widely distributed variety of red raspberry. The European red, which has been cultivated for several centuries in England and was one of the earliest fruits introduced into the United States, furnishes a superior berry but is adapted to the home garden rather than to commercial fruit growing. It is not so hardy as the American red, and instead of ripening for one marketable crop the berries ripen a few at a time, supplying the home table over a longer period.

The large loganberry is believed to be a hybrid between a wild blackberry of California and a red raspberry (*see* Loganberry). Burbank crossed the native dewberry, a fine flavored blackberry, with a red raspberry and produced a berry even superior to the loganberry, which has been given the name "Phenomenal." Another of his successes is the "Primus," a hybrid of a blackberry and a raspberry which bears fruit almost as large around as a penny, especially sweet and fine flavored.

The raspberry, which like the blackberry belongs to the genus *Rubus*, is distinguished from the latter by the fact that the ripe fruit comes off the stem like a small cap or thimble. The raspberries are propagated by root cuttings and by "layering," which means covering the branches with soil to induce them to take root. The black-cap raspberry forms new plants from the tips of the branches that bend over until they touch the ground and take root. Most of the garden varieties have very plain white flowers, but some of the wild raspberries are very ornamental in cultivation.

RAT. If you were asked to name the most destructive animal in the world, what should you answer? It might never occur to you to name the right one—the little despised rat, the king of destroyers! A distinguished biologist, who has studied the rat very carefully, says:

"The rat is the worst animal pest in the world. From its home among filth it visits dwellings and storerooms to pollute and destroy human food. It carries bubonic plague and many other diseases fatal to man and has been responsible for more untimely deaths among human beings than all the wars in history. In the United States rats and mice each year destroy crops and other property valued at over $200,000,000. On many a farm, if the grain eaten and wasted by rats and mice could be sold, the proceeds would more than pay all the farmer's taxes. The common brown rat breeds 6 to 10 times a year and produces an average of 10 young at a litter. Young females breed when only three or four months old. At this rate a pair of rats, breeding uninterruptedly and without deaths, would at the end of three years be increased to 359,709,482 individuals.

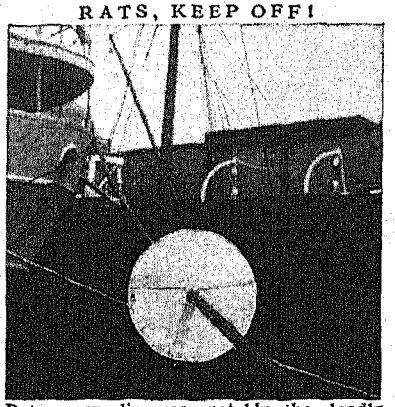
"Rats are omnivorous, feeding upon all kinds of animal and vegetable matter. The brown rat makes its home in the open field, the hedge row, and the river bank, as well as in stone walls, piers, and all kinds of buildings. It destroys grains when newly planted, while growing, and in the shock, stack, mow, crib, granary, mill, elevator, or ship's hold, and also in the bin and feed trough. It invades store and warehouse and destroys furs, laces, silks, carpets, leather goods, and groceries. It attacks fruits, vegetables and meats in the markets and destroys by pollution ten times as much as it actually eats. It destroys eggs and young poultry and eats the eggs and young of song and game birds. It carries disease from house to house and bubonic plague from city to city. It causes disastrous conflagrations; floods houses by gnawing lead water pipes; ruins artificial ponds by burrowing; and damages foundations, floors, doors, and furnishings of dwellings."

An Unwelcome Immigrant

The common house rat, known as the brown or Norwegian rat, was introduced into America from Europe shortly before the Revolution and has since spread over the continent. It is about nine inches long not including the tail. The black rat is smaller and weaker and flees from the brown rat, which is very aggressive. The wood, trade, or pack rat is noted principally for its amusing pranks. It is found in the southern part of the United States and on the Pacific coast from British Columbia to Central America. The cotton rat, found in the cotton belt, is a vicious and destructive animal. The coypu rat of the West Indies and Central and South America is the largest of the rats, attaining 20 inches in length and a weight of 8 pounds. The hamster of the northern parts of Europe and Asia, which is about a foot long, is a terrible pest to farmers. The kangaroo rat found in the southwestern part of the United States, is a gentle, harmless, handsome creature. It has short forelegs, long hindlegs, a long tail ending in a tuft, and it jumps like a kangaroo. It possesses cheek pouches for collecting food. A similar animal found in the sandy plains and deserts of Asia, eastern Europe, and northern Africa, is known as the jerboa, and is remarkable for the long leaps of which it is capable in escaping its foes.

The first step in getting rid of rats is to cut off their food supply by keeping foodstuffs and garbage in tightly sealed containers. The hungry rats will then eat poisoned foods or enter baited spring traps, which otherwise they would avoid. Cats are rarely useful for killing rats, but dogs are splendid rat-catchers, especially when trained and taught to hunt by themselves. Rat-infested ships, warehouses, and granaries can be fumigated with poisonous gases or protected by large cage traps. Buildings can be rat-proofed by closing up all wall openings and runways, and by substituting brick, concrete, or metal for wood in foundations and lower stories. For detailed information on how to get rid of rats, send for bulletins of the United States Public Health Service or the United States Department of Agriculture, Washington, D. C.

RATS, KEEP OFF!



Rats carry diseases, notably the deadly bubonic plague. To keep them from boarding ships or coming ashore from infected vessels, disks like the one shown here are placed around the mooring cables.

The name "rat" is applied in the stricter sense to large rodents of the mouse family (*Muridae*), and especially to members of the genus *Mus*, as the black rat (*Mus rattus*) and the brown rat (*Mus decumanus*). In a wider sense it is applied to certain rodents which are not *Muridae*, as the kangaroo rat and the coypu rat.

RATTLESNAKE. The rattlesnake is one of the most poisonous and dangerous reptiles. It seldom strikes, however, except in self-defense, and always gives a warning shake of its tail rattle.

This rattle is formed of a number of hard, horny cup-shaped joints, fitting loosely into one another. When the snake is excited, its sensitive tail vibrates; and the joints, striking together, give a rattling sound which may be heard for 20 yards. About 18 species of snakes carry rattles, and share the name.

Young snakes have only a blunt tip at the end of the tail formed by a knoblike growth of bone that is covered with thick skin. When the snake moults, or sheds its skin, this horny tip is retained and forms the first joint of the rattle. A new joint is added each time the skin is shed, and, as the snake grows larger, each joint is correspondingly larger and so causes the rattle to conform to the tapering shape of the snake. It is said that the joints of the rattle represent the years of the snake's life, but this is not always true, for well-fed snakes often shed their skin several times in a year, and furthermore the joints of the rattle often become worn and drop off. Specimens with more than 20 rattles have been found.

The rattler can strike effectively only from a coiled position, and then can reach only about two-thirds the length of his body. Usually the snake will sound his rattle and puff up and hiss before striking, hoping to drive away the intruder. But when the blow finally falls, it comes with the speed of lightning. The fangs, projecting almost straight out from the wide open mouth, sink in, driving home their poison. If the poison fails to stop the heart action of the victim, its peculiar quality frequently causes death by gangrene poisoning.

The different species of the group, which belongs entirely to the New World, are all of the sub-family of pit-vipers, which means that they all have a deep depression in the side of the head between the eye and the nostril which detects air vibrations (*see* Vipers). The habits of the species are similar. They are not vicious, but rather sluggish, and will slink away unless molested. When cornered they rattle and puff threateningly as if to frighten their foe. A rapid movement will provoke them and then they strike with fury. All species feed on rats, mice, and other small rodents. The young are born alive in late summer, and have the full poison equipment at birth.

The worst enemy of the rattler, aside from man, is the hog. They root the snakes out and make a meal of them, apparently with no bad results from the bite that may be inflicted. This is because the pig's tough skin and layer of fat under it does not allow the poison to enter the blood. The king and black snakes and certain birds of prey also eat the rattler.

As cold weather approaches, these snakes congregate in hollow logs, in caves, or under rocks and, winding themselves into a mass, sleep till spring.

The common or banded rattlesnake, found in the eastern United States, is of a bright tawny color marked with dark brown, and varies in length from 3 to 5 feet. It inhabits rocky and wooded places. The diamond rattlesnake of the Southern states grows to a length of 8 feet and is often 15 inches around. It is the bulkiest of all venomous snakes. This species lives in swampy places and swims well. Its yellowish body has plainly outlined diamond-shaped black blotches. The plains rattlesnake is a smaller, lighter-colored snake with less distinct markings, which grows to be about 30 inches long. It commonly makes its home in the burrows of the prairie-dog, where, an unwelcome guest, it ungraciously feeds on the young of its host. Other species are found in various districts of North and of Central America, and in parts of South America. Among the most curious is the "horned rattler" of the southwestern United States, which has hornlike cones above the eyes. It is also called "side-winder" from its peculiar habit of wriggling sideways over the ground. Most rattlers belong to the genus *Crotalus*, but the small ground rattlers are set apart in a separate genus, *Sistrurus*. Scientific name of common rattlesnake, *Crotalus horridus;* of diamond rattler, *Crotalus adamanteus;* of common ground rattler, *Sistrurus miliarius*. (*See* Snakes.)

RAVEN. The raven has a considerable historical background, for it was the first bird sent from Noah's ark, and it was the bird which fed the prophet Elijah. The raven was also the messenger of the Norse god, Odin, and its figure was on the flag that the early Northmen (Danes) carried into England. Some of the Pacific coast Indians place its image on their totem poles. Probably no bird is so widely mentioned in literature. Edgar Allan Poe in his poem 'The Raven' with its reiterated refrain of "nevermore" has immortalized this bird as the symbol of melancholy despair.

THE BIRD OF MOURNING

Poe's famous poem has given the Raven a reputation as a melancholy bird, but really he is impudent, inquisitive, and mischievous.

Ravens are found in almost the whole of Europe, in Africa, northern Asia, and America. With crows, jays, and magpies they make up the family *Corvidae*. Their somber black plumage adds to the age-old mystery surrounding them. They are as long-lived as man, and are perhaps the most highly developed of bird forms. Pairs mate for life and year after year use the same nest. They feed on small rodents and will eat the flesh of dead animals even when decayed. The raven's voice is harsh and croaking; but, like the crow, the bird can be taught to imitate sounds and speak a few words. In the United States ravens are found only in the west and southwest. They are common in Yellowstone and Glacier parks. Scientific name, *Corvus corax*.

RAVENNA, ITALY. This picturesque old city, lying in a marshy plain near the Adriatic Sea, 75 miles south of Venice, is interesting today chiefly for three reasons. The military expert remembers it as the scene of the great battle of Ravenna in 1512, in the Italian wars between France and Spain, and as the headquarters of a flotilla of American submarine chasers in the Adriatic in 1917–18 during the World War. The lover of literature sees Ravenna as the city where the poet Dante died and is buried. The artist and architect attach importance to the city because nowhere else are there so many striking examples of early Christian and Byzantine architecture and mosaics.

In the days of Emperor Augustus, Ravenna was a great Roman naval station with a harbor capable of sheltering 250 ships, but today it is separated from the sea by six miles of marshy ground, traversed by an unimportant canal. The industries are few, consisting mainly of wine making, breeding silkworms, and manufacturing lace.

The city presents a somewhat somber appearance, as if mourning for its glorious past. The most venerable of the churches is the cathedral of Sant' Orso, which dates back to Roman times, but which has been almost entirely rebuilt. There are 12 other churches or "basilicas" in Ravenna originally built between the 5th and 8th centuries, constituting a priceless architectural heritage of early Christianity. Another interesting historical monument is the two-storied tomb of the great Ostrogothic king, Theodoric, dating from about 520.

The battle of Ravenna, which was one of the bloodiest ever fought on Italian soil, is interesting because of the employment of artillery mounted upon carts. In this battle the famous French leader, Gaston de Foix, defeated the superior forces of the Spanish and papal armies, but was himself killed. This battle is memorable as a forerunner of modern warfare, in which trained and specialized armies take the place of the haphazard methods of feudal days.

Ravenna was taken by Theodoric the Ostrogoth in 492, after a three years' siege. For 200 years thereafter the city was the capital of the Exarchate of Ravenna, the last stronghold of the Eastern Emperors of Constantinople in Italy. It was taken soon after by Pepin, king of the Franks, who bestowed the entire exarchate upon the pope. In the later Middle Ages, however, Ravenna was ruled by tyrants of the Polenta family. When the lagoons on which Ravenna was built began to fill up, separating the city from the sea, it lost historical importance. In 1860 it became part of united Italy. Population, about 75,000.

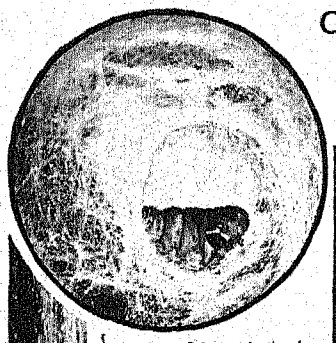
BEAUTIFUL CLOTH *Made Out of* CHIPS *of* WOOD

RAYON. A tree—a rough giant of the forest—changed into gleaming cloth! It sounds impossible. Yet each year whole forests of trees, chiefly spruce, are chipped and ground up to make chiffons, velvets, satins, and taffetas of silk-like rayon.

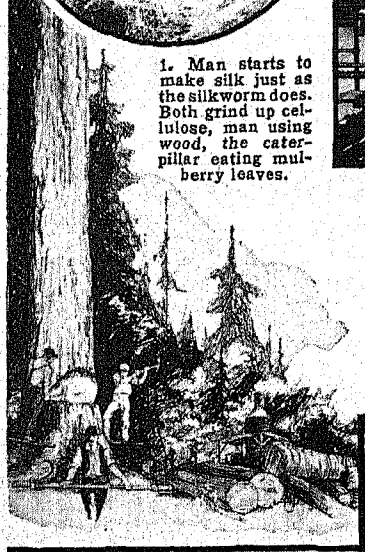
The silkworm gave man his first idea of making rayon. "Silk is only liquid gum," said Réaumur, the French naturalist, in 1734. "Could not we ourselves make silks with gums and resins?" Many tried to do this, but not until 150 years later was Count Hilaire de Chardonnet, a French scientist, successful. While helping the great Pasteur in the study of the silkworm, he noticed how the busy little spinners digested their mulberry leaves into a glue and then forced it out through two tiny holes (spinnerets) to form slender threads which solidified at once in the air (*see* Silk). Unable to match the digestive chemistry of the silkworm, Chardonnet dissolved mulberry leaves with nitric acid; and then he imitated the silkworm by forcing the mixture through tiny holes. Mulberry leaves he knew were part cellulose, a substance of which three-fourths of the vegetable

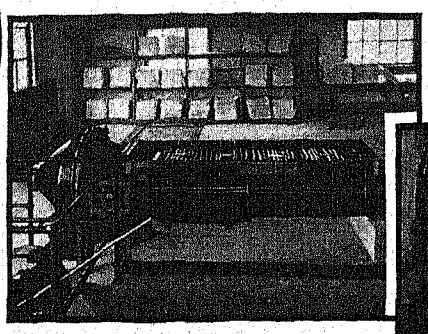
CHEMISTRY MAKES SILK FROM WOOD

How Man Imitates the Silkworm's Art

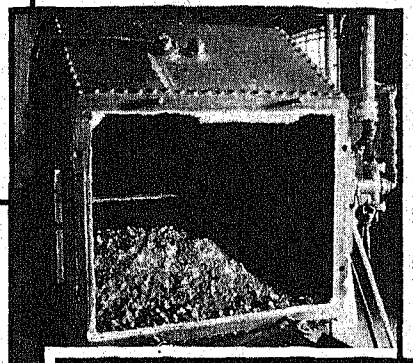


1. Man starts to make silk just as the silkworm does. Both grind up cellulose, man using *wood, the caterpillar* eating mulberry leaves.



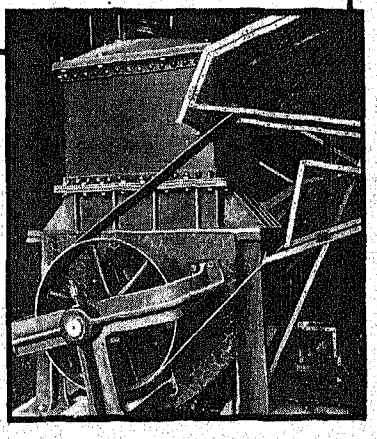


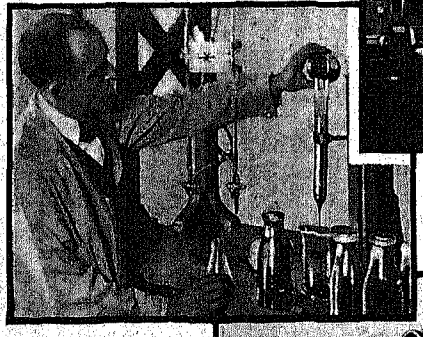
2. The wood pulp reaches the rayon manufacturer in the form of mats (left). These are steeped in caustic soda to form alkali-cellulose, and the excess caustic is squeezed out.



3. Now the mats of alkali-cellulose are ground up into crumbs by shredding machines and allowed to age. A batch of the fluffy snow-white crumbs appears at the right.

4. In the drum at the right the ripened crumbs are churned with carbon bisulphide to form cellulose-xanthate. The xanthate is mixed with caustic soda and comes out as a sticky solution called "viscose."

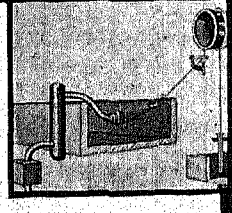




5. In these great spinning machines the viscose is forced through tiny openings into an acid bath, where it instantly hardens into filaments. These are twisted into thread and spooled on another machine.

There are four chief rayon processes: the viscose, nitrocellulose, cuprammonium, and acetate. The viscose is the most widely used. The pictures on this page, taken in the largest rayon mill in the United States, show the viscose process.

6. The thick, sirupy viscose is being tested by the man above. Skilled chemists are employed to keep their sharp eyes on every step in the manufacture of artificial silk.



7. Sometimes the rayon is spun in pots instead of on bobbins. The 18 or so filaments formed as the viscose comes out of the acid bath are carried up and over a roller and twisted into a single thread as they drop down into a rapidly revolving pot.

8. Next the spools or cakes of the twisted rayon threads go to the reeling machines (above, at right, where the thread is reeled into skeins. The reels stop automatically when the required number of yards have been wound, or when any of the threads break. Girls take the completed "flies" off, tie the skeins by hand, and hang them on poles. The skeins are now ready to be "finished." They are treated with sodium sulphite, washed, bleached, soaped, and dried.

9. The girl at the right is sorting and grading the finished skeins. Keen vision and a delicate sense of touch are needed for this work.

kingdom is composed (*see* Cellulose). He experimented further and got as good results with cellulose from tree trunks as he had with mulberry-leaf cellulose. His success led him in 1889 to build, in Besançon, the first factory for making "artificial silk," which we now call rayon. This began an industry which soon became one of the world's chief sources of clothing materials. For rayon soon passed silk and now rivals wool in quantity produced. Japan, the United States, and Germany are the chief producers.

Rayon differs from silk in chemical composition as well as in some physical properties. Silk is an animal protein containing nitrogen, while rayon is a vegetable carbohydrate. Early rayon was inferior to silk. It tended to shrink or stretch, to weaken greatly when wet, and to lose its gloss or sheen after wear. Industrial chemists and engineers have improved rayon in these respects, while retaining its original advantages. Rayon does not yellow with age. The threads do not rough up and catch dirt, as silk does. Because rayon does not cling, it is especially cool and suitable for summer wear. Chiefly responsible for the popularity of rayon, however, is its price—one-third to one-fourth that of silk. Chardonnet changed a luxury into an everyday commodity.

Efficiency of manufacture is one reason for rayon's cheapness. The silk worm takes four weeks to grow, eat its diet of mulberry leaves, and spin its 1,000 yards of silk fiber, which must be collected by hand. A single rayon spinning machine, in contrast, can run off a mile and a half of rayon thread in less than an hour.

Four Ways of Making Rayon

In the original *Chardonnet* or *nitrocellulose* process, purified cellulose from specially bleached cotton is nitrated by a mixture of nitric and sulphuric acids. The resulting nitrocellulose, similar to the raw material used in making explosives and celluloid, is dissolved in ether and alcohol, and yields *collodion*. This compound, forced through tiny holes or *spinnerets*, comes out in thin strands; many of these are spun together to make a single thread. The alcohol-ether solvent quickly evaporates, leaving threads of highly inflammable nitrocellulose. The nitrate is removed with sodium hydrosulphide or some similar chemical, which converts the threads back to cellulose again. This reaction also causes changes in texture and appearance, resulting in the finished rayon. This original method is now seldom used. Three new processes, all based upon, but differing from, Chardonnet's process have replaced it.

For the *acetate* or *celanese* process, cellulose from wood pulp or other sources is dissolved in a bath of acetic anhydride, producing *cellulose acetate*. This is precipitated in water, and the resulting precipitate is washed, dried, and dissolved in acetone. It then passes through the spinnerets into a stream of warm air which evaporates the acetone.

Less important is the *cuprammonium* (copper-ammonia) process, using cellulose from cotton linters, the short fibers which stick to the cotton seed after the bulk of the cotton is removed in ginning. The raw cellulose is dissolved in a solution of copper oxide containing ammonia; it is then filtered and forced through the spinnerets into a bath of sulphuric acid or caustic soda which removes the copper and ammonia, and hardens the threads. Bemberg yarns and threads are made in this way.

Commonest source of rayon is the *viscose* process, illustrated and described on the opposite page. A table showing other products made from viscose, cellulose acetate, and cellulose nitrate accompanies the article on Cellulose.

All the "cellulose silks" are called rayon, and manufacturers and dealers are required to use this term in labeling and describing them; but they may also use such trade names as "celanese" and "bemberg."

Some of the Uses of Rayon

The chief use of rayon is for women's clothing and household furnishings. Some rayon is also used for men's clothing, hosiery, and knit goods. Other less important uses are for upholstery, electrical insulation, and the fabrics of cord tires.

When threads of acetate rayon are woven with other fibers, "cross-dyed" patterns can be produced. The two fibers take dye differently, giving the cloth a two-toned pattern. Rayon "staple fiber," which is the ordinary "continuous filament" fiber cut into short lengths, is spun together with cotton or wool to produce a mixed fabric. Clothing made from rayon and wool is warmer than pure cotton but not so warm as wool. This fabric also lacks the resiliency of wool.

One of rayon's industrial advantages is its use of materials previously wasted. Cotton linters were a valueless remainder from cotton ginning until rayon appeared. Much of the wood pulp used comes from chips, blocks, saw-mill waste, and even sawdust. Some of the chemicals used are by-products of other industrial processes.

By varying the size of the spinneret holes, the number of strands in a single thread, and the chemicals used, manufacturers vary the strength, weight, and elasticity of the finished rayon. Thread has been spun so thin that a single pound would reach all the way across the United States. On the other hand, coarse threads are spun strong enough for weaving parachute fabric.

Chemically similar to rayon is cellophane, the thin, transparent substance used in wrapping candy, cigars, cigarettes, and a host of other products. To make cellophane, the cellulose solution is forced through a thin slit, treated with sulphuric acid, rolled thin, cleansed and dried, bleached with sodium hypochloride, bathed in glycerin to make it flexible, then moisture-proofed with a coating of a waxy lacquer.

Liquid cellulose is widely used as a quick-drying adhesive and cellulose cement. Other products made from the same solutions as rayon include artificial horsehair, artificial straw, and many plastics. (*See also* Pyroxylin Products.)

READING—*an* ART *of* COMMUNICATION

READING. When primitive men wished to communicate with someone at a distance or leave a permanent record, they drew pictures on stone or bone. When the first picture message was read, reading was born—how long ago no one knows.

To read such messages needed no schoolmaster's help. The pictures stood for objects that were familiar to the one who received the message.

From the pictograph stage, reading has advanced hand in hand with man's progress. It has become one of his most important everyday tools, the foundation of his education, the means by which he can receive communications from the great minds of all time. At the same time the art of reading words and symbols has grown more and more complex. Thousands of words are used to convey messages; strange little signs and guideposts are sprinkled over the pages of books and papers to help the reader—periods, commas, question marks, semicolons, all the signs of punctuation which are used to make meanings clear, to help show what the writer was thinking. Sentences use words in various patterns to tell what the writer was thinking. And sentences are woven into paragraph designs, which fit together to form the complete tapestry of the story.

With so many complicated mechanical devices to be mastered, careful training and long and hard effort are now required to develop skillful readers. Reading is the basic subject of the elementary school, the most necessary subject for the child to master, and the most troublesome. Failure in ability to read is one of the commonest faults of pupils, and lack of skill in reading is one of the greatest handicaps of adults. In recent decades educators and psychologists have been making every effort to learn the reasons for poor reading and to devise methods of helping people to become more efficient in this important art of communication. Some of their suggestions are given in this article.

Readiness for Reading

The most important skill in reading is the ability to follow the thoughts of the writer. Before little children read for themselves, they listen attentively to stories which they understand. They like the classics that tell about runaway rabbits and about children who are sent supperless to bed when they are naughty. They know these experiences from their contacts with life. When they have learned to read, they like stories which they can think about in the same way. Some children are never ready for 'Alice in Wonderland' because they cannot think the fantastic thoughts of the story. Einstein, put into the simplest words, is meaningless to those who lack the technical knowledge and experience which would make them capable of thinking with Einstein. Their minds are not ready for this work. Experiences which make background for interpreting what is read create "reading readiness."

If this basic principle were kept constantly in mind, reading would be simplified for learners and for those who have reading experiences. In the period of 25 years ago, children's readers were built upon the idea that small three-letter words were necessarily easy for children. We know now that the distorted ideas on which the stories about the C-A-T and the R-A-T were founded never entered the minds of boys and girls until they were implanted there by primers and first readers. Today it is not so much *simplicity* as *familiarity of ideas* that is desired. This principle can be applied to all reading. Simplicity of words does not always mean ease of understanding. Difficult thought may be expressed in familiar terms. "The child is father of the man," said Wordsworth. This thought is not so simple as the words.

Skills the Reader Must Perfect

In learning to read, much work goes into the perfecting of mechanical skill. Reading is at first usually oral; hence the reader develops certain habits which continue when he changes from oral to silent reading. His nerves and muscles and vocal cords tend to respond in silent reading as they did in oral reading. This often results in a habit of *vocalization*, or a silent pronunciation of the words as he reads. It may be seen in movement of the lips. Vocalization slows down reading, because the eye can read faster than the voice can speak. This can be proved by having someone read aloud and measuring how far ahead the eye is looking while the voice is pronouncing a word. The measure is called the *eye-voice span*.

Training the Eye

A trained eye is the most skillful and efficient servant of the reader. As you read, your eyes move from left to right across the page. They pause in their forward movement at the end of every three or four words. It is during this pause that you grasp the meaning of the phrase. The pause is called the *fixation pause*, and the number of letter spaces the eye records is the width of the pause. The eyes of a skillful reader move across the line smoothly and rhythmically, making few and brief pauses. Then they drop to the next line, catch it without fumbling, and repeat the process. Sometimes a reader does not understand what he is reading and his eyes jump backward on a line to read again words that he has been over. This is called a *regression*.

Eye movements in reading are now photographed to determine speed of reading, number of fixations per hundred words, number of regressions per hundred words, presence or absence of rhythm in reading, and muscular balance or imbalance of the eyes. Remedial measures of all kinds can be recommended by an expert teacher of reading.

Comprehension, Phrasing, and Vocabulary

Poor readers often read word by word, and sometimes do not even grasp one entire word at a glance. This happens because the reader does not recognize

words readily, or does not understand their meaning. This slows down or prevents the grasp of the author's thought. In contrast, a person who recognizes and understands words readily can give his thought almost entirely to the author's ideas or meaning. Indeed, the skilled reader sees and recognizes groups of words which convey a complete part of the thought. Such groups are called *thought-phrases.*

When the expert reader sees the following passage, for example, his eyes and his mind move along with the unhesitating precision of a machine in perfect alignment, pausing probably at the slanting lines:

Five miles to the north/arriving at a massive gate/that swung open at our approach/we entered a park/containing long lines of ancient cedar trees/set in formal array/through which, for a matter of two miles/we moved slowly/coming at last to an open space.

One who wishes to become a skillful reader will learn to recognize words quickly and accurately. A *w-a-s* called *s-a-w* will distort the meaning of a sentence. One who confuses similar words will often have to retrace his steps. Careless readers merely look at unfamiliar words—sometimes not even guessing at their meanings. This habit leaves the reader with blank spots or blurred impressions. To overcome these faults it is necessary to practise word recognition constantly. Street signs and newspaper headlines offer abundant opportunity to train the eye.

To become a good reader one must learn words—more and more words. A reader's recognition vocabulary is usually much larger than his speaking vocabulary; that is, he can read with understanding many words that he cannot use in conversation. Words may be learned from the context; that is, their meaning may be guessed from the meaning of the rest of the sentence. This is an excellent method of learning words, but when in doubt a reader should consult the dictionary.

How to Become a Rapid Reader

Should one read speedily? If a person reads with comprehension but slowly, should he try to gain speed? By all means, yes. Life is too short and there is too much to read for us to dawdle over easy reading. Then too the rapid reader is usually the most efficient reader because he remains alert.

The following table, taken from 'The Ophthalmo-graph', a pamphlet published by the American Optical Company, shows the average speed per minute made by good readers at different grade levels:

Grade	Low I	High I	Second	Third	Fourth
Words per Min.	20	45	90	138	168

Grade	Fifth	Sixth	Seventh	High School	College
Words per Min.	182	216	230	260 to 300	320 to 350

A good adult reader should be able to read a minimum of from 250 to 300 words per minute of textbook or nonfiction material of average difficulty. A reader's rate varies, of course, with the type of subject matter he is dealing with and with the purpose for which he is reading.

You can determine your speed by setting an alarm clock which will interrupt you at the end of four minutes of effective reading. Count the words read and divide by four to find your average per minute. You will find the following plan a good one for practise in increasing your speed:

1. Determine to read rapidly.
2. Select easy material, familiar and interesting.
3. Practise for four minutes; read as rapidly as possible but test comprehension by repeating the gist of what is read; count words read and get average per minute.
4. Practise at short intervals frequently.
5. Practise with critical mindedness.
6. Graph your progress.

The "Will to Learn"

To become a good reader it is of the utmost importance, of course, that one should *will* to read well. The will to learn is the most important factor in the learning process. The "will to learn" does not mean merely a momentary determination. It means, rather, the force which dominates those who choose to become masters of an art or a skill. Lack of the will to read well is responsible for more failures in this field than is lack of ability.

The reader should approach the reading hour with a fresh mind and seek interest in the *ideas* set forth; that is the prime purpose of reading. Without this interest, it is well-nigh impossible to concentrate; with it, concentration is easy.

Comprehension of reading is thinking with the writer, absorbing his ideas. Many things interfere with clear comprehension. A number of them have already been pointed out. Difficulty with the mechanics of reading, for example, handicaps comprehension since it turns the attention of the reader from the subject matter to his own difficulties. So also a limited vocabulary makes it impossible for the reader to get the author's full meaning.

Techniques and Purposes of Reading

To repeat one other point, the power to think logically is indispensable to good reading. This means that a good thinker, as he reads, does some of the following things well:

1. He recognizes the main thought.
2. He subordinates auxiliary thoughts.
3. He separates principles from illustrations and examples.
4. He uses key words and key sentences as effective guides to thinking.
5. He practises stating clearly and briefly the writer's thought in his own words.
6. He reflects upon reading after reading; he examines the conclusions of the writer and forms his own.

None of these skills will develop without conscious effort. Power to do these things distinguishes the mature reader from the immature. The immature reader insists on remembering everything—he reads a book of popularized science and he repeats every detail of it, and nothing can prevent him. But the mature reader selects, organizes, summarizes, and evaluates what he reads, and his discussions are refreshing.

The ability to get the best results from reading depends upon certain *techniques of reading* which the skillful reader uses. Some of the most useful techniques are:

1. Finding the central thought.
2. Recognizing key words and sentences.
3. Outlining.
4. Summarizing.
5. Determining general principles and specific illustrations.
6. Reviewing systematically.
7. Interpreting by bringing other knowledge to bear upon the reading.
8. Reproducing in one's own language.
9. Skimming.

The techniques to be used will vary, of course, with the purpose of the reading. Before we discuss them, let us have in mind some of the major purposes for which people read. Educators list several both for work-type reading and for reading for pleasure or recreatory reading. Among the major purposes of work-type reading are:

1. To acquire information.
2. To draw conclusions.
3. To form opinions.
4. To find answers to questions or problems.
5. To discover new problems.
6. To evaluate materials.
7. To acquire more effective modes of reasoning and thinking.
8. To visualize details.

Reading to acquire information is the purpose of most newspaper reading, and of reading time tables, maps, guide books, encyclopedias, dictionaries, technical books, legal documents, and dozens of other materials which come up in the routine of everyday life. It is a simple matter to develop the skill necessary to read for information efficiently. The memory must be keen, the powers of observation accurate, and judgment and reason must be active. First of all, however, the skillful reader must know where to go for the information he wants and how to locate it quickly. He must know what tools will help him—catalogs, dictionaries, encyclopedias, books, magazines, newspapers—and he must know how to use these tools. He must understand their make-up and know how to use the aids the author has given him—tables of contents, indexes, headings, and so on.

Among the techniques which will help the reader to train his mind to read for information efficiently are outlining, summarizing, finding key words and key sentences, and finding central ideas. Tables of contents and topical headings should be a help in outlining a book or chapter, if the author has made the best use of these devices. Key sentences to paragraphs or sections and central ideas should be easy to find if the work is well written. In good expository writing each paragraph is a unit of thought. Often the first sentence states the thought that is going to be developed.

As the reader of a newspaper turns from the first page, where, for example, he has been informing himself on the latest developments in Europe, to later pages, his purpose for reading changes almost imperceptibly. He finds the editorial section and reads the articles there to draw valid conclusions or to judge the soundness of the statements made. In this type of reading, the reader is called upon to use judgment. He must draw upon his previous information on the subject, his experience, and his reason, in order to decide whether or not his mind is in agreement with that of the writer.

Readers can train themselves in developing judgment by setting problems in this type of reading. A good plan is to analyze three or four editorials on the same subject for their varying points of view, their persuasiveness, and their general effectiveness. Current periodicals are good sources for this type of reading, since one frequently finds the same subject treated differently in parallel or in consecutive issues.

We must constantly keep in mind that reading can never be looked upon as passive reception of ideas. It is an act requiring constant mental activity carefully directed.

Discovering Reading Interests

We must also remember that reading is a self-directed activity. The desire to read, the selection of our reading, and the benefit we derive from it depend, in the long run, entirely upon ourselves. "Know thyself," says the old adage. That doctrine applies here. Discover your interests, and insist on *your* books, *your* exercises, *your* reactions. Browsing among books and current reading materials in libraries and book shops is an excellent way to discover latent interests. This habit also gives practise in the technique, or skill, of skimming. A question that we want answered or a problem that we wish to discuss may lead us to a single article that will open up a whole field of reading to us. Thus we make associations independently—a practise which we should cultivate all through our lives.

Splendid books pour from the presses, each of them the effort of someone to communicate his knowledge to people who are interested in his subject. Why do explorers write books? Because there are hundreds of potential explorers who will respond to their stories. It is inconceivable that books would continue to multiply if there were no potential readers for them; it is inconceivable that more readers would not be waiting for books if all minds knew their own needs.

Arnold Bennett, in his 'Literary Taste', talks of the "vital essence" breathed into the reader by the writer. Reading breathes into the reader a life-giving essence which should be translated into living. To read a book today and to translate it into action or into a philosophy of life tomorrow is to integrate reading with living. To read a book and to let it lie without reflection in the mind is to dull the powers of the mind. Reading is, above all, a means of growth.

Some Helpful Books on Reading

Teaching High School Pupils to Read: A Study of Retardation in Reading. By Stella S. Center, and Gladys L. Persons. (Appleton, 1937.)

How We Think. By John Dewey. (Heath, 1933.)

The Art of Thinking. By Ernest Dimnet. (Simon & Schuster, 1928.)

How to Use Your Mind. By H. D. Kitson. (Lippincott, 1933.)

Streamline Your Mind. By James Mursell. (Lippincott, 1936.)

READING (*rĕd'ing*), PA. Thomas and Richard Penn, sons of William Penn, who founded Reading in 1748, probably chose the site because of the beauty of the surroundings and because it is only 58 miles northwest of Philadelphia. Two other advantages have contributed to make Reading today one of the most important industrial centers in the state. First, it is very near rich coal supplies, so that it has ample fuel at low cost. Second, it has splendid transportation facilities. The city manufactures a variety of products. Its plants for the manufacture of wrought iron pipe, hosiery, glove silk underwear, builders' hardware, and braid are among the largest in the country. There are large locomotive and repair shops and extensive manufactures of small steel castings, thread-lace and hosiery machinery, spectacles, children's shoes, menthol cough drops, and foundry products. The Schuylkill River flows past Reading on the west, while the Neversink Mountains and Mount Penn flank it on the east. It is the center of a rich farming country. Population (1940 census), 110,568.

REAPING MACHINES. The earliest farmers probably used the sickle to reap their grain, for scientists have found sickle-shaped stone implements among late Stone Age remains. As civilization advanced, the scythe and the cradle scythe were invented. With the sickle and the scythe farmers everywhere laboriously cut their grain until well into the 19th century. Then the development of the reaping machine revolutionized agriculture and gave the world cheap bread.

Between 1820 and 1860 various reaping machines were devised, but only McCormick's "American reaper," invented in 1831 (*see* McCormick, Cyrus H.), has survived. Its click around the world has become "the music of an international anthem."

Later machines carried the cut grain up to men riding on a side platform, who bound the grain by hand and dropped the sheaves on the ground. Then came the modern harvesters, or self-binders, which whip a twine around a bundle of grain and drop the finished sheaves. A more recent attachment ties seven to eleven sheaves in a shock, and sets it on end. A machine called a stripper or "header" merely cuts off the heads of the grain, leaving the straw standing. The "combine" is a remarkable machine which cuts and threshes in one operation (*see* Threshing). Special machines have also been constructed for cutting corn, rice, and other crops.

The BANNER *of* MERCY *on the* FIELDS *of* SUFFERING

Origin of the Red Cross Societies and Their Noble Work—The Symbol of Help and Comfort in Flood, Fire, Pestilence, and War

RED CROSS SOCIETIES. It was the end of a hot stifling day in June, in the year 1859, at the close of the terrible battle of Solferino. Napoleon III of France, who had led the allied French and Sardinian armies to free northern Italy from the yoke of Austrian supremacy, had won the victory. But such a victory! The carnage made even the victorious Napoleon III welcome peace. Fifteen thousand dead and wounded lay on the field of battle; days passed before the few surgeons could attend to all the wounded, and many perished before help reached them.

At this time a young Swiss, Henri Dunant, happened to be traveling through the battle area, and his heart was rent by the agonizing cries of the wounded. As best he could, he bathed and dressed their wounds, brought water to those burning with fever, and cheered and comforted the sufferers. He gathered a number of women in the nearby Italian city into a band of volunteer nurses, who, following his example, ministered to friend and foe alike, repeating *Tutti fratelli* (All are brothers) as they cared for French, Austrians, and Italians, friend or foe, without distinction.

Henri Dunant never forgot the terrible scenes he had witnessed. He wrote a pamphlet describing them so vividly that his appeal moved the hearts of all who read it. He showed how much of this suffering and death could be avoided by an organization to protect and care for the wounded in war, "without distinction of nationality."

His plea finally resulted in an international conference at Geneva in 1864, at which 14 nations

drew up a treaty, called the Geneva Convention. This provided for the protection of societies to be organized in time of war for the care of the wounded. In honor of Dunant, the flag of his native Switzerland, with its colors reversed—a red cross on a white field—was adopted as the symbol of this protection. In Mohammedan lands the cross is not used, and different symbols are used in the various countries. The Turkish organization, for example, uses a red crescent and is known as the Red Crescent Society.

Ten years before the Geneva conference, Florence Nightingale and her band of nurses had gone out to care for the wounded soldiers of the English army fighting the Crimean War. During the Civil War in the United States, a voluntary Sanitary Commission had served to nurse the federal troops. The work done by these groups showed how much suffering could be avoided by skilful and devoted nursing. Later, under the Red Cross, this service to mankind was organized on an international scale, operating in peace and war alike, without religious or political discrimination.

FIRST AID NEAR THE BATTLE FRONT

In the first World War the Red Cross performed invaluable service near the front lines, particularly in assisting the overtaxed Army Medical Corps. This shows a dressing station maintained with the assistance of the Red Cross near St. Gilles, France, during the Marne-Aisne advance in the summer of 1918.

The International Organization

Each of the national Red Cross societies is an independent organization. But the societies communicate through the International Red Cross Committee in Geneva, Switzerland, and hold meetings every few years. This committee is a neutral body composed entirely of Swiss citizens. It guards the principles of the Convention and acts for the various societies in judicial problems arising from war. It is through this committee that the national societies offer their assistance to warring countries. The League of Red Cross Societies coördinates peacetime activities.

Organization of the American Red Cross

Although the United States was represented at the Geneva conference in 1864, it did not sign the Red Cross Convention until 18 years later. Clara Barton, whose service to soldiers near the front during the Civil War had earned her the name "Angel of the Battlefield," organized the American branch in 1881, and became its first president (*see* Barton, Clara). The next year the President of the United States signed the Convention. In 1905 the organization was reincorporated under a charter from Congress and renamed the American National Red Cross. The president of the United States serves as its president, and appoints the national chairman and one-third of the central committee. Membership is open to any citizen or resident of the country. The society is financed solely by contributions from the public. Its accounts are audited by the War Department.

In peacetime, relief to the victims of disaster is an important part of Red Cross work. In 1889, for instance, when a dam above Johnstown, Pa., gave way sending a wall of water 75 feet high pouring down upon the city, the Red Cross took care of the sufferers. In 1906, when one-third of San Francisco was burned, the Red Cross rushed food and clothing to the homeless. Wherever disaster strikes—flood, fire, storm, famine, or mine explosion—Red Cross workers are there to help.

The society is active in many other fields. It instructs civilians in first aid and establishes first-aid stations along the highways. It teaches swimming, life-saving, and home safety (*see* First Aid; Safety). It also instructs mothers and children in home hygiene and care of the sick, and maintains a corps of nurses who care for the public health. Its Volunteer Special Services include sewing, knitting, and making surgical dressings; transcribing books into braille for the blind; aiding nurses in hospitals and clinics; sponsoring courses in nutrition; and operating canteens during disasters.

How can the Red Cross act so quickly and efficiently in time of emergency? First, it is officially designated by the government to supplement the work of the Army and Navy medical units, and in that capacity it functions under an international treaty. Second, it maintains a permanent trained staff to direct its great army of volunteers in any emergency. Finally, public utilities, newspapers, radio, railroads, planes, ships are always at its command.

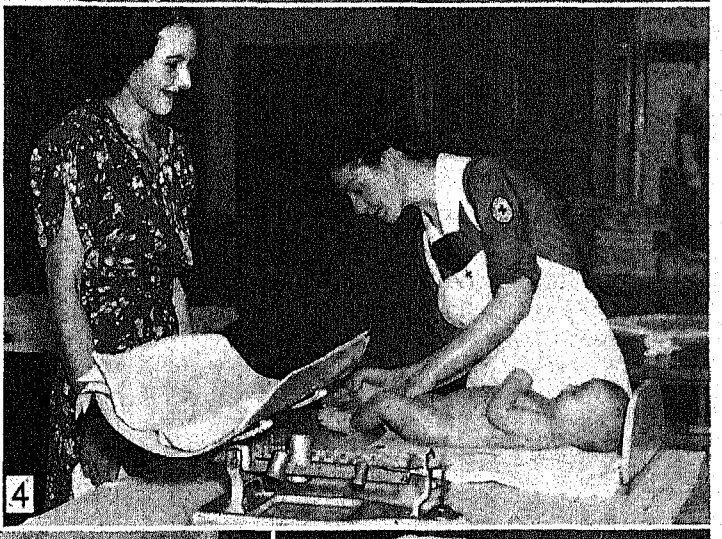
Work of the Junior Red Cross

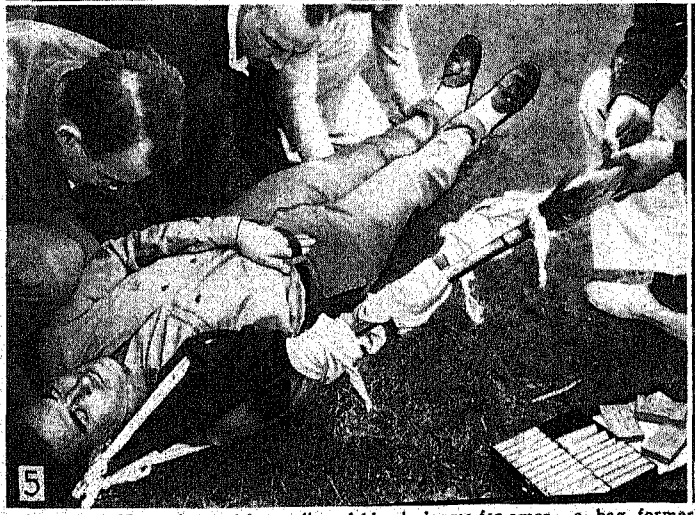
The American Junior Red Cross, organized during the first World War, sews for hospitals and studies hygiene and first aid. Members carry on safety and health crusades, and work to promote civic welfare and international good will. They write letters and make scrapbooks to show the children in distant lands what the customs and industries of the United States are. In time of war, funds are established for the care of children in bombed cities.

Services in Time of War

In wartime, Red Cross activities are organized on a tremendous scale. Societies all over the world work

THE RED CROSS IN WAR AND IN PEACE





1. Loading a Navy plane with supplies of blood plasma for emergency transfusions. These cartons will be delivered by parachute to Army field hospitals or to ships at sea. 2. Serving food and hot drinks to rescue workers in a bombed city. 3. Caring for orphan children in China. Notice that the baby is tucked into a bag formerly used by the American Red Cross in distributing rice. 4. Teaching a mother to take care of her child. 5. Teaching first aid. After applying a broomstick splint to a broken arm, these civilians are preparing to carry the patient to shelter. 6. Transcribing books into braille for the blind.

together to perform a multitude of services. They distribute medical equipment and supplies of all kinds and provide rest stations where soldiers can obtain refreshment. The nursing service trains thousands of nurses to tend the wounded. In addition to ordinary medical care, the Red Cross dispenses blood plasma for emergency transfusions. It directs evacuation and cares for refugees. It handles the legitimate and necessary personal correspondence with residents of enemy or enemy-occupied territories. A recreation corps entertains soldiers in hospitals. Another bureau searches for missing men and gathers information concerning the sick, the wounded, and the dead. Messages are transmitted between prisoners of war and their families, and food and other supplies are sent to the prisoners. The home service looks after soldiers' families, giving them financial assistance when necessary.

The methods of "total war" employed by the Axis powers in the second World War placed new responsibilities on the Red Cross. Civilians as well as armed forces became military targets. Besides the enormous task of helping soldiers and sailors, the society was called upon to extend relief to entire populations suffering from enemy air raids. In coöperation with civilian defense agencies, it provided air-raid protection for people in bombed areas.

When wars are over, the Red Cross assists in returning prisoners to their own countries. It helps the disabled to readjust themselves by giving them loans and free training in crafts, and assists civilian populations in reconstructing their communities.

To finance its activities, the American society makes national campaigns for funds. In time of war Congress appropriates large sums for the purchase of food for the Red Cross to distribute among refugees. Food, clothing, and medical supplies are sent all over the world.

RED RIVER. Although it is only about 310 miles long, circumstances have made this stream one of the important rivers of North America. For many years it was called the Red River of the North, to distinguish it from the Red River of Louisiana. It starts at Wahpeton, N. D., at the junction of the Bois des Sioux and the Otter Tail rivers. Both of these streams have their source among the lakes in the west central part of Minnesota, only a few miles from the source of the Mississippi. They add another 400 miles to the total length of the Red River. Flowing northward, the main stream forms the boundary between Minnesota and North Dakota, then enters the Canadian province of Manitoba, and empties into Lake Winnipeg, which finds its outlet into Hudson Bay. The Bois des Sioux issues from Lake Traverse, which at high water connects with the Mississippi so that, with a few portages, one could journey by canoe from Hudson Bay to the Gulf of Mexico.

The Red River Valley was once the muddy bed of ancient Lake Agassiz, which covered an enormous area during the Ice Age. Almost as flat as a table top, its rich black soil free from stones and tree stumps, this valley is now one of the world's most famous wheat-growing regions.

In the Red River Valley occurred one of the tragic episodes of Canadian history, the Red River rebellion of 1869. In that year the half-breeds or *métis*, who had settled to the number of about 10,000 in the Red River Valley, rose in rebellion against the Canadian government, which had just acquired this region with the rest of the immense possessions of the Hudson's Bay Company. A provisional government was established by the rebels at Fort Garry (now Winnipeg), headed by Louis Riel. A force under Sir Garnet (later Lord) Wolseley crushed the rebellion the following year, and Riel fled to the United States. Following a subsequent rising in 1885, in which Riel played a leading part, he was tried and convicted of treason and hanged.

RED SEA. This busy sea lane between the Indian Ocean and the Mediterranean has for centuries been one of the world's greatest trade routes. Since the days of the Phoenicians, nations have struggled to control its waters and the rich traffic between Europe and the Orient that flows through it. After Great Britain gained possession of India and Australia, the Red Sea became a vital link in British commerce.

It lies like a narrow trench, 1,200 miles long, between the Arabian peninsula and the northeast coast of Africa. From a maximum width of 250 miles, it narrows to 20 miles at the southern end, where the Strait of Bab el Mandeb ("Gate of Tears") leads into the Gulf of Aden and the Indian Ocean. On the north the Red Sea forks into two prongs—the Gulf of Aqaba on the east, the Gulf of Suez on the west. Between the prongs lies the wedge-shaped Sinai Peninsula. The Gulf of Suez reaches to within 100 miles of the Mediterranean. The intervening strip is called the Isthmus of Suez. For two thousand years cargoes were carried overland from sea to sea by camel caravan. Then in 1869 a canal was cut across the isthmus, and the Red Sea took first rank as a commercial highway (*see* Suez Canal). The shore to shore traffic consists chiefly of boatloads of Mohammedan pilgrims from Africa bound for Mecca. They land at the Arabian port of Jidda.

The Arabian coast is a narrow sandy plain, backed by barren coral hills and high limestone ridges. On the African side lie the broad deserts of Egypt and the Sudan, and the arid tablelands of Ethiopia. Navigation of the sea is difficult and dangerous. Jagged, hidden coral reefs abound. Sudden squalls are common, and there are few safe harbors. The heat is often extreme and exhausting. The temperature of the waters averages 80° F., and so rapid is their evaporation that the sea is excessively salty. The color of the water at times is actually red, due to myriads of red algae. Except in the shallow Gulf of Suez, the average depth is 1,500 feet.

The children of Israel are believed to have made their miraculous crossing of the Red Sea at the northern tip of the Gulf of Suez. The dramatic story is told in the Bible in Exodus xiv.

REFLEXES. Touch your finger to a hot stove and it will jerk away before you have had time to think of the hurt. You are born with this automatic tendency to draw away from things that are painful to the touch. You can see how useful is this tendency. If you had to stop and think before you took your finger off the stove, you would be much more severely burned.

This is just one sample of the many automatic reactions called reflexes, which work through inherited patterns of nervous connection, like automatic telephone circuits. A sense organ receives the message, a sensory nerve carries it to a connection center in the brain or spinal cord, where a return message is *immediately* sent back along a motor nerve to the muscle that must do the work. This structure within the nervous system that furnishes the mechanism for reflex action is known as the *reflex arc*.

Another example of a simple reflex is the "knee-jerk" often used by physicians to test the soundness of our nerves. If one of your legs is hanging freely, as it does when you cross your knees, a sharp blow just below the kneecap will produce a sudden and uncontrollable kicking movement. Less than a tenth of a second is required for the impulse to pass through the necessary nervous connections. Shade a cat's eyes from a bright light and the pupils will grow large. Now remove your hand quickly and you will see the pupils promptly contract to a narrow slit. This protective reaction against excessively bright light which might otherwise injure the extremely sensitive optic nerve takes place in your own eyes. Notice the size of your pupils on a bright day in a mirror, and then again on a dark day or in dim light. This reaction is present from birth on.

Reflexes not only involve the reaction of muscles but of glands as well. When food is placed on the tongue the salivary glands are stimulated and the "mouth waters." During great emotional excitement, such as fear or anger, another set of glands, the adrenals, react by sending an emergency messenger, called adrenalin or epinephrine, through the blood stream. (*See* Gland.)

Classes of Reflex Reactions

The reflex reactions that make up the behavior of animals are numberless, and special types of more or less complicated pattern are peculiar to certain creatures. So it is that various lizards drop the tail when this appendage is grasped; the crab amputates an injured leg; and the octopus wraps its tentacles about its prey. Most reflexes, however, can be placed in the following main classes:

1. The Nutritive Reflexes. If a hungry infant is touched on the cheek, he will turn his mouth in the direction of the stimulus. A touch on his lips will produce the suckling reflexes, which involve the lips, the jaw, the tongue, and the palate. As soon as food enters the mouth, saliva flows and a rhythmic swallowing begins. The stomach glands produce digestive fluids and the stomach walls begin churning movements which continue the processes of digestion.

The foregoing chain of events illustrates the fact that a reflex is often teamed together with other reflexes into a more or less complicated pattern. Frequently one reflex will itself provide the stimulus for another; thus the swallowing reflexes bring food into the stomach, and the presence of the food sets off the next step in digestion.

The entire group of nutritive reflexes, together with the tendency to be restless when hungry, are sometimes spoken of as the "hunger instinct." From this point of view, an instinct is merely a combination of interacting reflexes.

2. The Respiratory Reflexes. Breathing is governed through a reflex center in the medulla, called the respiratory center. This receives stimuli from various parts of the body. For example, a dash of cold water makes you gasp. Sighing, sneezing, and coughing may all be regarded as reflex interruptions of the normal breathing rhythm.

The respiratory center is influenced also by certain chemical changes in the blood. When you use up the oxygen in your blood more rapidly than usual by violent exercise, the excess of carbon dioxide that accumulates in the blood stream is carried to the nerve centers, where it produces an automatic discharge of impulses to the muscles of the chest and diaphragm. These muscles respond immediately by pumping air more rapidly into the lungs to provide the additional oxygen the blood is calling for. So powerful is this respiratory reflex that it is impossible for a man to suffocate himself by holding his breath. The reflex is stronger than the will.

3. The Postural Reflexes. A muscle is active even when it is not visibly doing work. It has a tension or muscle tone, which determines our postural attitudes, in other words the way we hold ourselves. When these posture tensions are weakened (as in extreme fatigue) we appear listless and flabby. On the other hand, when they are too active we become awkward and tense, as in the case of the overanxious athlete who is so highly keyed to his task that he is unable to make a graceful and smoothly relaxed movement.

4. The Locomotor Reflexes. Some animals can walk as soon as they are born. The new-born calf, for example, soon struggles to his feet and tags after his mother, showing a sequence of reflex adjustments not very different from the walking of the mature animal. In the human infant the ability to walk develops slowly during the first year and a half, perhaps due not so much to practise as to a gradual inner ripening of inherited reflexes.

5. The Manipulative Reflexes. In some of the higher mammals, such as cats, raccoons, and monkeys, and particularly in apes and in man, we may note a variety of reflex tendencies involving the hands. If an object is placed in a baby's palm, he closes his fist over it in a fairly uniform and mechanical manner. At a slightly later age, various pulling, pushing, and exploring reactions develop, some of them resulting from combinations or changes in the original reflex patterns.

A very curious reaction involving the hands is the "grasp suspension reflex." A young baby will almost always grasp a rod which is offered him, and sometimes with one or both hands support his whole weight in the air.

This monkey-like response disappears after a few months, and we may say that the reflex has been lost through processes of growth. Infants whose development is slow (as in the case of the mentally retarded) sometimes retain the reflex for a much longer period. Of course an older child can readily support himself in the same manner, by grasping a bar, but in this case the reaction is a voluntary one, rather than a direct and automatic reflex.

6. Reproductive Reflexes. These include the responses involved in the various phases of mating behavior. Nest building offers an instructive example of a chain of reflexes, which are useful in reproducing the species, and yet which probably involve no deliberate purpose or aim. During the mating season, a sparrow reacts to twigs, horsehair, and bits of string by picking them up and dropping them in a convenient nesting place. Later she reacts to this accumulation of nesting materials by weaving them into a nest, and finally the completed nest proceeds to serve as a stimulus to laying eggs.

7. Defense Reflexes. A stimulus of pain, applied to any part of the body, will result in a prompt reaction of avoidance. The case of the finger jerking away from the hot stove was an example. Perhaps the simplest type of a defense reflex is the blinking of the eyelids when something touches the outer surface of the eye. Defense reflexes may take the form of an aggressive struggling, rather than a withdrawal. A kitten that is startled by being roughly picked up, may retaliate by cuffing, scratching, thrusting, and kicking. Along with these reactions occur certain internal changes, such as an increase in blood pressure and in the rate of the heart-beat, which contribute to the total state known as emotion.

How Reflexes Are Changed

Up to this time we have considered reflexes only in their original or inherited condition. But all reflexes are subject to change. In the human adult most reflex actions are modified, and comparatively few activities belong to the pure reflex type. Even such a simple reflex as winking may be reinforced or partly inhibited by voluntary central control; and the same motor paths which carry impulses for the winking reflex also conduct impulses for voluntary winking and closing of the eyelid. We may experience an impulse to sneeze and at once inhibit this reflex. Again the reflex response itself may be altered (as when the knee-jerk becomes weaker in illness) or the response may remain the same, but become associated with an entirely new starting point or stimulus. The process by which a new connection is established between a stimulus and a reflex is known as "conditioning."

The method by which a conditioned reflex is developed was first studied experimentally by the famous Russian physiologist, Pavlov. Pavlov made the experiment of ringing a bell every time he fed meat to a certain dog. After a time he found that the reflex which brought saliva to the dog's mouth at the taste of meat could be started by simply ringing the bell without giving the animal any meat. The bell had become for the dog so closely associated with the sensation of tasting the meat that it was capable for a time of acting alone as a substitute for the normal stimulus of appetite.

Conditioned Reflexes Influence Habits

Some writers regard conditioned reflexes as of fundamental importance in human development, especially in child training. Habits are described as consisting merely of patterns or systems of conditioned reflexes. The simple conditioned response, however, differs from an original response and from a well-established habit in being less regular and less permanent.

The process of conditioning no doubt plays an important rôle in our emotional life, and in our everyday likes and dislikes. A psychologist has reported the case of a high-school girl who was intensely afraid of spiders. The sight of even the most harmless little red mite would provoke a scream and symptoms of uncontrollable fear. It was found that when she was a little girl she had been bitten by a large spider. The bite itself was not at all serious, and she might have taken it in a matter-of-fact way, except for the excitement and distress shown at the time by her mother. The girl's normal reflex from the pain of the bite, which would ordinarily have resulted merely in avoiding contact with spiders, became conditioned by her mother's excitement so that it resulted in extravagant terror at the mere sight of one.

Often a conditioned response becomes rationalized; that is, we seek to justify it and give it a rational basis, although its origin lies in some accidental association of events. A boy who was eating an apple bit into a caterpillar. Disgusted, he threw the apple away, and for some time afterwards he refused to eat apples in any form. He was, as we say, "conditioned against apples." He tried to explain his dislike by saying that apples had a bad taste that season—but we know it wasn't really the taste of apples, but of caterpillars, that he objected to.

"Re-conditioning" Reflexes

One method of dealing with a conditioned reaction that is unreasonable is by "re-conditioning." A child who had been frightened by a dog, and who was as a result afraid of all hairy or furry animals, was cured of his fears in this way: A rabbit in a cage was placed about ten feet from the child's breakfast table. On successive days, at breakfast time, the rabbit was moved a little nearer, until presently the child would tolerate him quite near, and after breakfast would even open the cage and play with him. The child who had been conditioned against furry animals by an unpleasant association was now re-conditioned in favor of them by a pleasant association.

The GREAT DRAMA *of the* REFORMATION

The Most Far-Reaching Revolution in the Religious History of Europe—The Men and Measures That Figured in It—Origin of the Name "Protestant"—The Catholic Counter Reformation

REFORMATION, PROTESTANT. At the beginning of the 16th century, all Western Europe was Catholic. But a widespread movement of opposition to many of the doctrines and practises of the church had long been gathering force, under the leadership of such reformers as John Wyclif and John Huss. This opposition came to a head in the early part of the century. Western Europe was thenceforth split into two religious groups—the Catholics, who remained faithful to the ancient church, and the Protestants, who separated from it and formed many independent branches.

So far-reaching and momentous were the results of this Protestant Reformation that it is taken as one of the turning points of history, ushering in the Modern Period. As religious unity was destroyed, Europe became sharply divided along national lines, and new political, social, and economic doctrines and problems arose.

Leaders of the Reformation

The small group of leaders in the revolt were little aware of the avalanche their ideas would release. Foremost among them was Martin Luther, the Saxon monk who in 1520 publicly burned the papal bull condemning his doctrines and who, when summoned before the imperial diet to answer for this action, said he would not recant "until I am convinced by the testimony of Scripture" (*see* Luther, Martin). Luther's disciple and colleague in the University of Wittenberg, Philipp Melanchthon, became the chief theologian of the German Reformation and "schoolmaster of the German nation." Melanchthon's kinsman, Johann Reuchlin, fostered the study of Hebrew and attacked his scholastic enemies with ridicule in the witty 'Letters of Obscure Men' (*Epistolae Obscurorum Virorum*).

Other striking figures of the Reformation in Germany included the monk Johann Tetzel, who was attacked by Luther for "selling indulgences"; Ulrich von Hutten, the wandering poet and turbulent foe of the papacy; and Tauler of Strasbourg, whose teachings of "heart religion" directed Luther to the doctrine of "justification by faith."

Reformers in other lands rivaled in zeal their German contemporaries. Erasmus, the great Dutch forerunner of Luther, stimulated research into the organization and teachings of the early church through his printed editions of the Greek New Testament and the writings of the church fathers. Le Fèvre of France and Zwingli of Switzerland arrived independently at views similar to Luther's.

In England John Colet worked for reform within the church along the lines desired by Erasmus. John Calvin made Geneva the world center of Puritanism. Ignatius de Loyola, Spanish noble and soldier, founded the Society of Jesus (Jesuits), which became one of the chief Catholic agencies in checking the further progress of Protestantism. From Stockholm to Seville men took sides in the tremendous religious controversy.

Many Other Forces at Work

The Renaissance had in a measure paved the way for the Reformation by fostering a spirit of religious skepticism derived from the study of the pagan cultures of ancient Greece and Rome (*see* Renaissance). The political situation in Europe also helped to extend the conflict, for many local rulers, particularly in Germany, were eager to throw off the domination of the Holy Roman Empire, then headed by the strongly Catholic Emperor Charles V. In many quarters tradesmen and peasants were agitating their social and economic grievances against rulers and landowners, and believed that the church authorities sided with their oppressors.

Luther's challenge of old religious doctrines and traditions provided a rallying point for these forces of discontent and a motive for breaking established ties. Thus many diverse groups, from princes to peasants, regarded him as their especial leader. Gradually they saw that this monk was not the voice of any special group or interest, and by 1530 many had drifted away into indifference or opposition to him. By that time the movement had passed beyond control, even beyond the control of Luther.

Development of Luther's Doctrines

After Luther's first formal criticism of church practises had been condemned by Catholic authorities, he rapidly developed his new teachings. He rejected the authority of the pope, and—like Wyclif and Huss before him—set up the Bible as the sole source of Christian truth. He denied that priests had any power that laymen did not possess; and declared that the vows taken by monks and nuns were not binding and that monasteries should be abolished. He rejected the celibacy of the clergy and all but two of the seven sacraments—the Lord's Supper (Eucharist) and baptism—and profoundly modified at the same time the teaching concerning the Eucharist. By 1520 he was definitely a rebel against the pope and the church.

Landmarks in the Reformation

The chief landmarks of the Reformation, so far as relates to Germany, were these: Luther's posting of his Ninety-five Theses against indulgences (1517); his burning of the pope's bull and the books of the canon law (1520); his appearance and condemnation at the Diet of Worms (1521); the Peasants' Revolt,

THE AGE OF THE REFORMATION AND THE RENAISSANCE

On this crowded canvas the artist, Wilhelm von Kaulbach, has brought together the chief actors in the great drama of the New Age, many of whom never met in actual life. On the platform at the rear Luther holds aloft the Bible, while around him cluster other theologians of the period. Against the two pillars to the right and left stand the two great monarchs who championed the Protestant cause, Gustavus Adolphus of Sweden and Elizabeth of England. In the right alcove Gutenberg, with Renaissance artists at his side, holds up a printed sheet. In the left alcove Copernicus, Galileo, and others expound the new astronomy. In the left foreground, geographers and discoverers hover over the globe to which Columbus has recently given a New Continent. Hans Sachs, the shoemaker poet, sits in the center of the foreground. In the distance back of him is a group clasping hands over the Religious Peace of Augsburg. A little nearer and to the right sits Shakespeare listening to laurel-crowned Petrarch; back of them are Erasmus and Reuchlin. In the right corner are fragments of Greek and Roman art which the Renaissance had taught men to venerate.

which the nobles, urged on by Luther, put down with great cruelty (1525); the Diet of Spires (1529) which decreed that religious changes should cease and the rights of the Catholic church be restored; the protest against this decree (whence comes our term "Protestant") signed by the Lutheran minority in the diet; the wars fought by Charles V to maintain the Holy Roman Empire against the claims of France and the German princes; and the advance of the Turks (Mohammedans) to Germany's doors through the conquest of Hungary (1526)—all of which hindered the emperor's free dealing with the Lutherans; the adoption of the 'Augsburg Confession' setting forth the Lutheran faith (1530); the Schmalkaldic War (1546–47), in which the Protestant forces were defeated by those of the emperor, largely through the defection of Maurice of Saxony, one of their number; the religious Peace of Augsburg (1555), in which the emperor was at last forced to grant to the ruler of each German state the right to choose between Catholicism and Lutheranism. For more than a half-century this treaty gave to Germany religious peace. (*See* Thirty Years' War.)

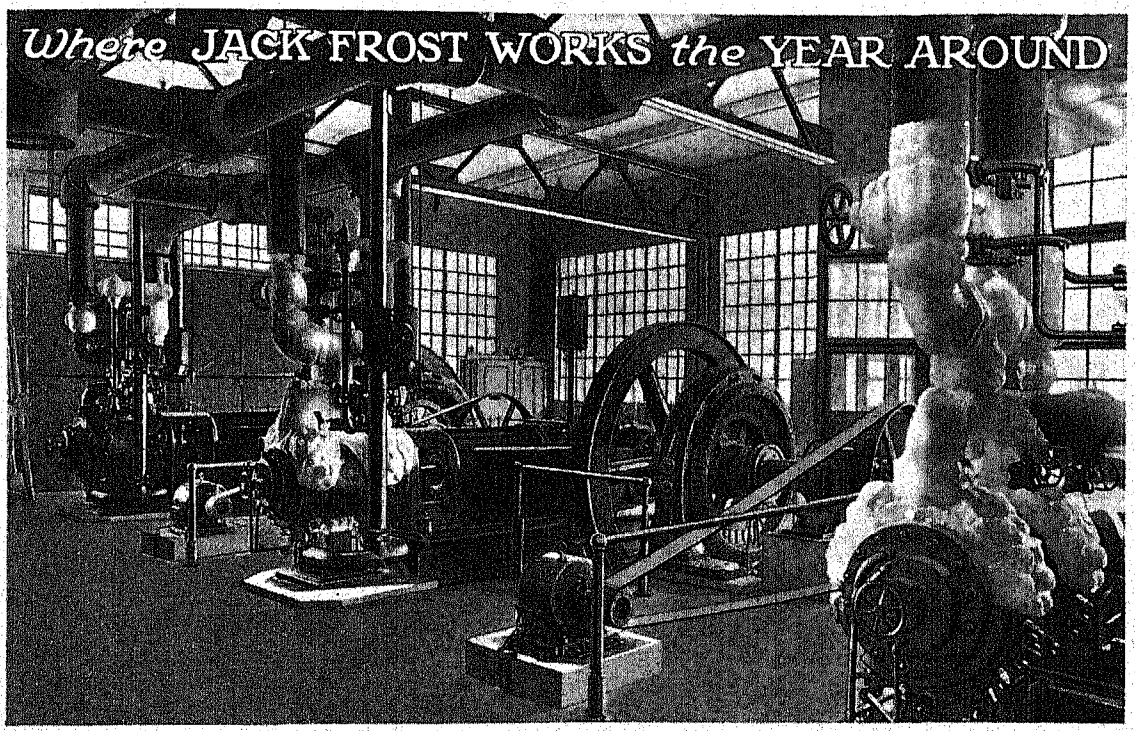
The Lutheran faith established itself chiefly in northern Germany and Scandinavia. The Swiss, French, and Dutch movements drew their direct inspiration from a similar movement launched by John Calvin a generation later—a movement which inspired Scotland through John Knox (*see* Calvin; Knox). The English Reformation began when Henry VIII broke with the pope in 1534 (*see* Henry, Kings of England); but the introduction of Protestant doctrine in the Anglican church did not come until the reign of Edward VI.

At the beginning of the Reformation the authorities of the Catholic church did not realize the extent of the danger which threatened it, for they regarded the movement as merely one of the many dissensions and schisms to which the church had always been more or less subject. When they saw the revolt spreading into country after country, and taking so firm a hold on the minds both of rulers and of people, their eyes were opened and they proceeded with zeal and energy to repair the breaches that had been made. The Society of Jesus, founded by Ignatius Loyola in 1540, supplied an army of scholars whose policy and devotion proved invaluable. By the decrees of the Council of Trent (1545–63) the church corrected many of the abuses complained of and reaffirmed its ancient doctrines and traditions. A succession of able popes during the latter half of the 16th century then followed the policy marked out for them by this Counter-Reformation, and thus removed the incentive to revolt in lands that were still loyal.

To quote the language of Lord Macaulay: "Two reformations were pushed on at once with equal energy and effect—a reformation of doctrine in the north and a reformation of manners and discipline in the south. In the Order of Jesus was concentrated the quintessence of the Catholic spirit; and the history of the Order of Jesus is the history of the great Catholic reaction."

Thus the middle of the 16th century saw the tide of the revolution checked. By the close of that century Europe was divided between the two forms of Christianity by almost the same lines as exist at the present day. To quote again from Macaulay: "As Protestantism had driven Catholicism to the Alps and Pyrenees, so Catholicism rallied and drove back Protestantism, even to the German Ocean; nor has Protestantism in the course of 200 years been able to reconquer any portion of what was then lost."

For additional information *see* the related articles: Charles V; Loyola; Luther; Wyclif; Zwingli.



The Interior of a Modern Refrigerating Plant, Showing the Machines which Produce Artificial Cold

REFRIGERATION. Artificial cold, or refrigeration, is almost as important as fuel in our complex modern life. Not only does it supply us with refreshing cold foods and drinks in summer, cool our theaters and other large public buildings, and preserve our foods in the home, in warehouses, and in transportation (not to speak of keeping our furs free from moths in summer storage); it is actually a necessity of life in cities, especially for babies, who sicken and die without the fresh milk which usually can be preserved during summer only by ice or some other means of refrigeration.

The first house for storing ice was built in 1805. From 1860 to 1870 people began to know the advantages of refrigeration, and many ice houses and cold storage plants were built, using natural ice. Then came the invention of the refrigerator car for shipping perishable food. The first of these cars ran from

Chicago to New York in 1867 with a load of beef. Now transportation companies maintain thousands of refrigerator cars; whole trainloads of perishable foodstuffs are shipped daily the length and breadth of the country. New England ships that once took cargoes of natural ice to India and Eastern ports have been replaced by giant freighters with refrigerating systems, carrying meats from the United States, Australia, and Argentina to markets thousands of miles distant.

The marketing of perishable foods faces another change through the discovery of quick-freezing methods by which meats, fish, vegetables, and even fruits, packed in the same containers which the purchaser will receive, are frozen at a temperature of 50° below zero in only an hour or so, as against 10 to 48 hours for slow freezing. Under quick-freezing methods cell walls in the foods are not broken down by the formation of large ice crystals, and thus the natural juices are retained, and texture and flavor are kept unchanged for an almost indefinite period.

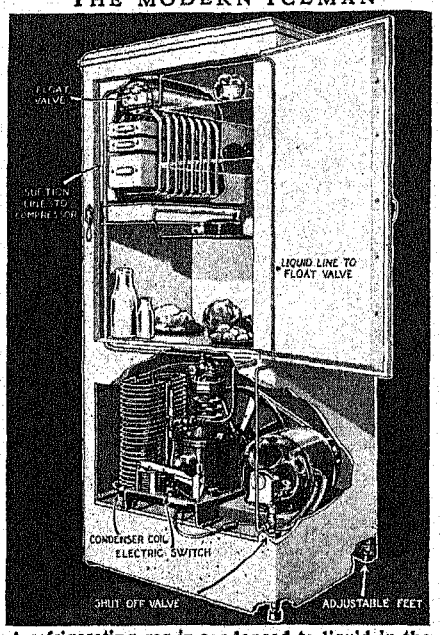
Another change is coming in methods of handling such products. Refrigerator cars now using ice in chambers with air circulation systems will have to maintain far lower temperatures by means of mechanical systems, either in car units or in master cars, distributing refrigerant through feed lines to the other cars. Cakes of solidified carbon dioxide gas (marketed under such names as "dry ice") also may be used. They are 15 to 20 times as effective refrigerants as ice, and evaporate directly from solid to gas without giving off troublesome liquid.

Refrigeration is also an important element in the new art of "air conditioning." Large refrigerating units are used in summer with the conditioning plants of theaters, factories, and large buildings, to maintain correct temperature and humidity. "Room size" units are available for homes and offices. Railroads find summer air conditioning of passenger trains especially helpful in attracting business.

The first refrigerating machine was a device to make ice, invented by Dr. William Cullen in England in 1775. The first United States patent was secured in 1851 by Dr. John Gorrie, who invented a compressed air refrigerating machine as a means of cooling sickrooms and hospitals.

Present-day refrigeration systems work on the principle that cold can be produced artificially (1) by the liquefaction of a solid, as in the melting of ice, by itself or with a brine solution to aid melting; (2) by the evaporation of a liquid; (3) or by the expansion of a gas. These processes produce cold by absorbing heat (*see* Evaporation; Freezing).

THE MODERN ICEMAN



A refrigerating gas is condensed to liquid in the lower condenser coil. The liquefied gas is led up through the liquid line to the cooling unit in the upper box, where the float valve regulates the amount admitted. The expansion of the liquid to a gas makes the coils very cold by extracting heat from the surroundings. The cooling unit therefore acts like a cake of ice which never melts. The gas is then drawn down through the suction line to the compressor pump, where it is again liquefied, cooled, and stored in the coil, ready to repeat the cycle.

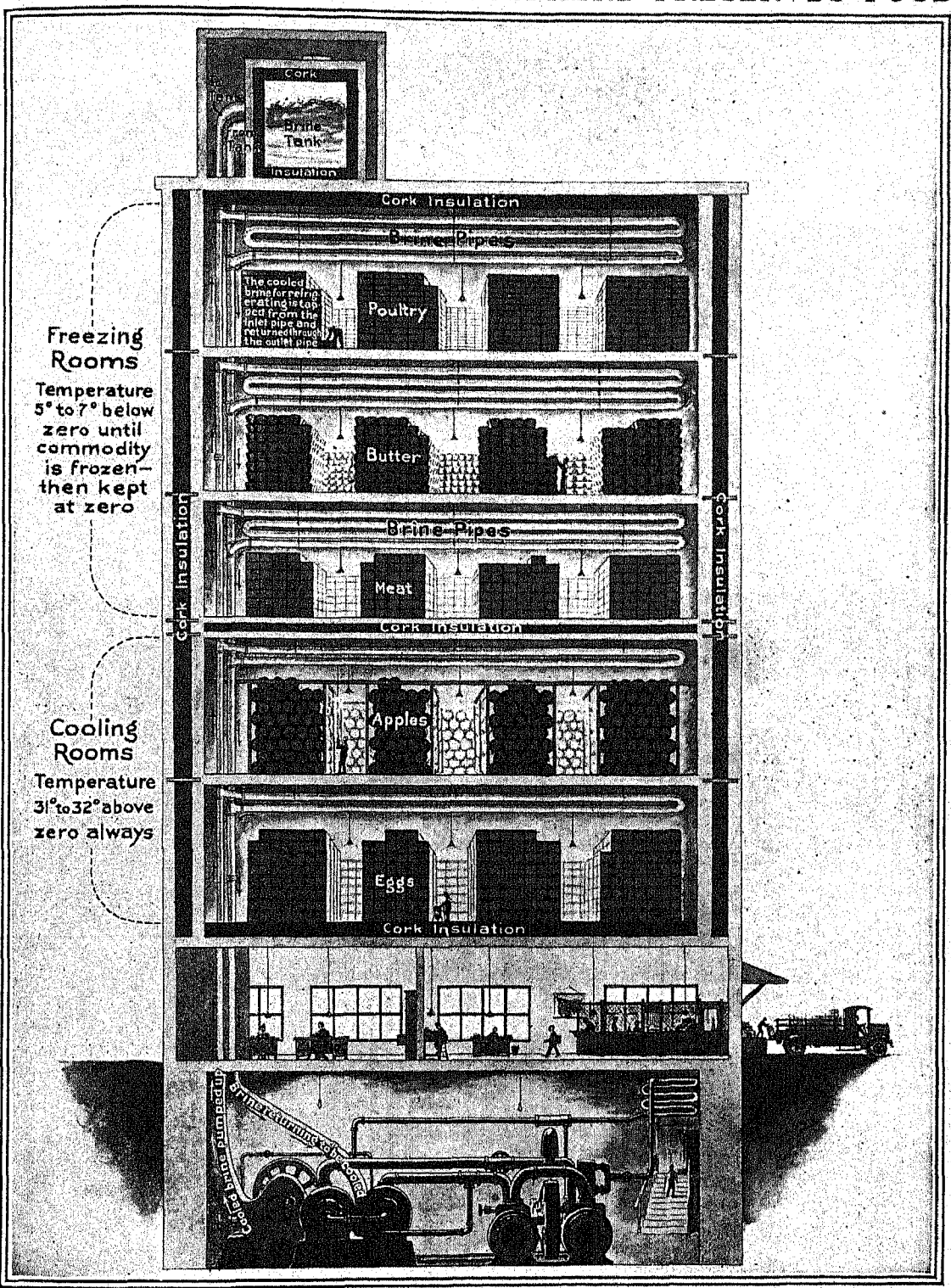
In mechanical systems of refrigeration, the *compression*, the *absorption*, and the *vacuum* systems depend upon the evaporation principle. The compression system is based on the cooling effect of expanding gas. In many artificial ice plants anhydrous (waterless) ammonia is used by being first compressed by machinery, cooled to normal temperature, then released through needle sprays into parallel rows of pipes running through a brine tank, in which stand rectangular cans filled with distilled water. The heat in the brine is absorbed by the expanding ammonia, becoming very cold, without freezing, while the water in the cans freezes to ice.

In the "can" system many cans are frozen at once, and then lifted by a crane and dipped into a tank of hot water to loosen the cake of ice. In the "plate" system, the coils cool flat plates on the side of a reservoir in which the ice forms. During the process of freezing in the can system, the "core" or unfrozen center of the cake is removed, and with it the accumulation of air bubbles and mineral sediment which prevent the formation of clear, transparent ice. This is usually done with a suction device, and the space left is filled with clear, distilled water. The ammonia gas, having absorbed heat from the brine, must be cooled with running water before being returned to the compressor for use over and over again. Water supply is important in making artificial ice, for not only must the water for ice be clear, and free from mineral matter, but ample quantities for cooling the refrigerant must be available. Many plants both filter and distil the water that goes into the ice cans for freezing.

In absorption systems, cold is produced by the evaporation of volatile liquids, such as aqueous ammonia. It begins the cycle as a strong solution in water. When the solution is heated the ammonia is driven off, and then sent through the same course as in the compression system, to be recovered by absorption into the water again.

Vacuum systems cool water into ice by its own evaporation, speeded up in a vacuum produced by mechanical means. In some machines strong sulphuric

WHERE "NORTH POLE" ATMOSPHERE PRESERVES FOOD



This shows how the interior of a great cold-storage warehouse is arranged. In the basement is the refrigerating machinery, which maintains a circulation of chilled brine throughout the storage floors. On the first floor we see the offices; then come the cooling rooms, where foodstuffs that would be injured by too much cold are kept. Higher up are the freezing rooms, where, by providing more brine pipes to the room, an intense cold is maintained. The building is lined with insulating material in order to keep out heat from the surrounding air.

acid is used to absorb the water vapor, in addition to the air pump. Compressed air machines, used chiefly in scientific apparatus, are constructed on the principle that when a compressed gas expands it absorbs heat from its surroundings, cooling them to a low point.

How the Home Refrigerator Works

In your home refrigerator you will find a freezing unit, or frost coil, with a space for freezing ice cubes or ice cream. The operation of the refrigerator is described below the picture illustrating the home machine. If it is one of many controlled by a single unit, as in large apartment houses, the condenser coils, the compressor, and the motor, run by either electricity or gas, may be located in the basement, feeding a compressed refrigerant to many boxes. Ammonia, sulphur dioxide, methyl or ethyl chloride, and other refrigerants are used. All except carbon dioxide are harmful if breathed into the lungs; but they are considered safe, with the exception of methyl or ethyl chloride, as they give off a pungent odor when there is a leak. The chlorides are made safe by mixing them with some gas that gives off a warning odor.

It took ten years, from 1914 to 1924, to sell the first 10,000 mechanical home refrigerators in America. Then came a boom which grew until in ten years more than two million units were being sold each year.

The temperature in the food compartment of the refrigerator should be kept between 32° and 50° F., to prevent the rapid growth of harmful bacteria. Below 32° the food freezes; over 50° the bacteria begin to thrive and multiply.

Most food keeps best if covered, preferably with wax paper, since this covering retains moisture and prevents a mingling of odors and flavors. Milk, cream, eggs, and uncooked meat or fish belong in the coldest spots. Leftovers, and fruits and vegetables with little odor should have the next coldest place. Odorous fruits and vegetables should be put in the warmest section farthest from the freezing unit.

Cold Storage Houses

The refrigerating machines used in storage houses, whether used for the safekeeping of furs or food, or in factories for special industrial purposes, such as in candy factories for keeping cream centers in the proper state of hardness, are merely larger developments of the same sort of machines. The compressor, motor, and condenser units are located in a suitable spot and the refrigerant is piped to the various rooms, where automatic controls maintain the temperatures at the points desired. It is this fact of controllability that has led to the wide use of automatic refrigeration. We are no longer dependent upon ice made by natural processes, or upon the cooling power of ice made artificially, as far lower and more constant temperatures may be obtained by refrigerating machinery.

Natural Ice Still Used

Although artificial ice making has become a great industry, large quantities of natural ice are still used; and collecting and selling natural ice is yet an important industry. In harvesting natural ice, the surface is first scraped to remove snow and débris. Then a marker, with knives at the bottom, is run across the surface to cut parallel grooves. Following this comes the heavily weighted ice cutter, with longer knives which cut nearly through the ice. Men with hand saws complete the cutting, after which the ice is floated in long cakes to the runways of the storage house, where it is cut into smaller blocks, and packed away in sawdust for later use. (*See also* Cold Storage; Meat Packing.)

REGINA (*rē-jī'na*), SASKATCHEWAN. A glance at a map of Saskatchewan showing the spider-web of railways that radiate from Regina will make clear why this city is the commercial as well as the political capital of the province. From Regina go out every year millions of dollars worth of hardware, groceries, clothing, and agricultural implements, to supply the fast-growing farm population of this great young province. Grain elevators, flour mills, wood-working establishments, foundries, machine shops, and an oil refinery are among the many industrial plants. Like many other cities of the Canadian Northwest, Regina has adopted municipal ownership, owning its street railway, light and power plant, waterworks, and stockyards. Besides the splendid buildings of the provincial parliament, Regina has many other imposing structures, among them the Regina College, St. Chad's College, and the provincial normal school.

The town site of Regina was laid out in 1883, to serve as the seat of government of the Northwest Territories and as headquarters for the Royal Northwest (now Royal Canadian) Mounted Police. In 1905 Regina was made capital of the new province of Saskatchewan. Population (1936 census), 53,354.

REIMS (*rēmz;* French *răⁿs*), FRANCE. Standing in the path of German bombardment for four years, Reims was virtually blasted into ruins during the first World War, 1914–1918. Only about a hundred houses were left fit to live in. As the story of destruction became known to the world, Reims came to be called a "martyr city," and its fate was one of the most dramatic chapters of the war. For more than two years several thousand of its residents huddled underground in the vast wine cellars tunneled in the chalk that forms the foundation of the region. In 1917 complete evacuation was ordered for the devastated city.

Reims (also spelled Rheims) is situated on the Vesle River in northeastern France, about a hundred miles from Paris. After the war it was rebuilt as a model city, with a garden suburb for industrial workers. The chief industries are the manufacture of champagne, fine woolen fabrics, soap, paper, glass bottles, and wooden casks for the wine trade.

Only the ancient Mars Gate and the glorious medieval cathedral link the new Reims with the old city. The gate is a triumphal archway of Roman days, dating from the third or fourth century. The cathedral of Notre Dame, built in the 13th century, is one of the most famous in the world. During the first World War it was struck by hundreds of shells, and fire

burned out the wooden interior. But the 13th-century builders did their work so well that not even the long bombardment destroyed the main structure.

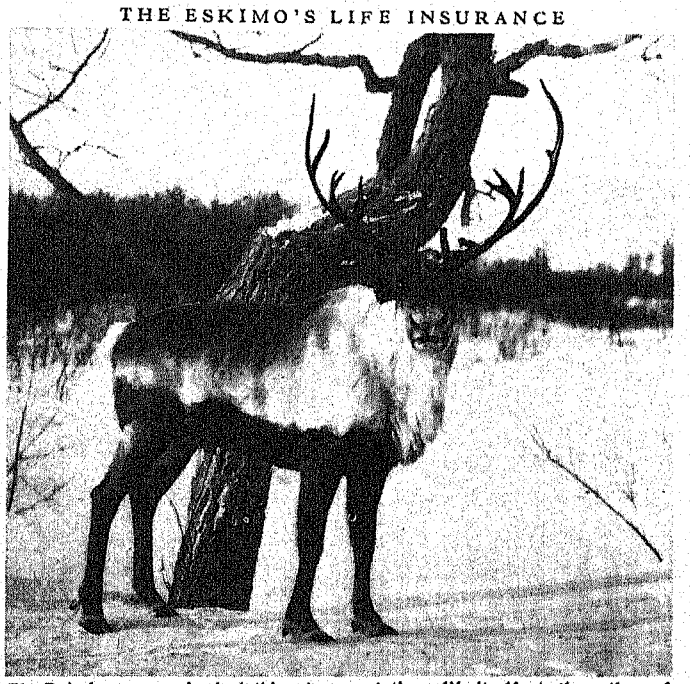
The cathedral has since been restored at large cost, principally through the generosity of John D. Rockefeller, Jr. The reconstruction was a marvel of ingenuity and patience; fragments of the old stained glass windows were laboriously pieced together for some of the new. In the days of the French monarchy, Reims was the national cathedral, and it was there that Joan of Arc brought Charles VII for his coronation. The cathedral was unharmed during the second World War, and the city itself was little damaged. Population, about 115,000.

REINDEER. Stories of Santa Claus and his swift reindeer steeds have made these animals familiar to children of many countries. Santa's neighbors living on the Arctic border of the Old World, from Lapland to the Bering Sea, have used the reindeer for centuries to take the place of cattle, horses, and other domestic animals, for they furnish food and clothing and pull sledges. American reindeer are called caribou; so the word "reindeer" is usually applied to the species found in Europe and Asia.

Unlike other members of the deer family, both sexes of the caribou and reindeer possess antlers. In winter they live on lichens, which they dig out from under the snow; and in the short Arctic summer they fatten at an astonishing rate on grass and other vegetation. Usually they migrate in summer to the coast from their winter feeding grounds in the highlands. An adult reindeer sometimes attains a height of five feet at the shoulders, and can pull a load of 300 pounds over the frozen tundras at nine or ten miles an hour for several hours.

The American caribou has never been domesticated, and the great herds of reindeer which furnish a livelihood for many of the Alaskan natives are all descended from Siberian reindeer. The United States Office of Education imported 1,280 of these between 1892 and 1902 to replace the fast vanishing caribou. The natives serve as apprentices in the care of herds for four years, receiving at the end of that time a specified number of animals. These wise governmental regulations advanced the Alaskan Eskimo in less than a generation from the stage of nomadic hunters to the pastoral stage of civilization. It has been well said that "a reindeer herd is an Eskimo's bank account." Scientific name of reindeer, *Rangifer tarandus.*

THE ESKIMO'S LIFE INSURANCE



The Reindeer means food, clothing, transportation—life itself—to the natives of the Arctic. This stag's antlers show that he is in his prime and ready to fight any adversary for the supremacy of the herd.

RELIGIONS OF THE WORLD. Of the world's great religions Christianity has by far the greatest number of followers. Nearly one-third of the entire population of the world—about 700,000,000 people—profess some form of this faith. It is the great proselyting religion. In 2,000 years of missionary work, migration, and conquest, its adherents have carried its teachings to every continent. Today Europe, America, and Australia are overwhelmingly Christian, while the Christians in Asia and Africa are steadily increasing in numbers and in influence in the daily life of the people.

In the last quarter of a century, while most other religions have stood still or declined, the number of Christians has grown by many millions. In this same period the number of Mohammedans, too, has shown a remarkable increase. This growth of Mohammedanism is due to a revival of the proselyting spirit, in which Islam has been second only to Christianity. Missionary activities and military conquests carried this faith from its birthplace in Arabia (*see* Mohammed and Mohammedanism) across northern Africa into Spain, through Asia Minor into European Turkey and the Balkan states, and east across Asia to the East Indies, until now more than 225,000,000 Moslems answer the daily calls to prayer. Many converts are being made in pagan countries, especially in Africa. Here progress is rapid because of the nearness of the Mohammedan countries, and the racial prejudice against Europeans and their social and religious institutions.

Numerically greater than the Mohammedans, but less aggressive, are the 350,000,000 Confucianists and Taoists of China. They are the followers of two Chinese teachers, Confucius and Lao-Tse, each of whom sought to establish a workable system of practical

morality, Confucius emphasizing social service, and Lao-Tse passive individualism, as the means of attaining the greatest good (*see* Confucius). The original teachings of Lao-Tse have been so buried under a mass of superstition and magical practices that Taoism is today little more than a degraded system of spirit worship.

Hinduism is the chief religion of India, with about 230,000,000 adherents (*see* Hinduism). Buddhism, which also arose in India, spread over central and eastern Asia, and now claims around 150,000,000 adherents (*see* Buddha). In China and Japan it has existed for centuries along with the older religions, Confucianism, Taoism, and Shintoism. Shintoism, the folk religion of Japan, was largely absorbed into Buddhism when the latter faith was brought over from China. At the restoration of 1867 Shintoism replaced Buddhism as the state religion, but later it was disestablished and its rites were merely retained as part of the state ceremonials. With the spread of modern education it has rapidly declined until now it has but about 25,000,000 followers.

Judaism, the first of the great monotheistic religions (those teaching the doctrine of one God) has been carried westward by the Jewish migrations from Palestine until three-fifths of some 16,000,000 Jews in the world are in Europe, and almost a third in America—mostly in the United States.

The Christian church has three main divisions, the Roman Catholic, Eastern Orthodox, and Protestant churches (*see* Church). No authoritative statistics have ever been assembled; latest unofficial estimates put the numbers of adherents at about 300,000,000, 144,000,000, and 200,000,000, respectively.

The Roman Catholic church thus claims nearly half the total number of Christians. The population of Europe, Latin America, and Oceania is predominantly Catholic, with the Eastern Orthodox church leading in the Balkan peninsula, Asia Minor, Syria, and Russia; in Great Britain and North America the Protestants make up nearly two-thirds of the total Christian population.

The Eastern Orthodox church, which separated from the Roman Catholic church in the 11th century, adhering to the primacy of the Patriarch of Constantinople while the Roman Catholic church adhered to the primacy of the Bishop of Rome, includes the Greek, Hellenic, Russian, Serbian, Bulgarian, Syrian, Rumanian, and other churches. Various other churches, including the Armenian, Nestorian, Coptic, and Abyssinian, which do not belong to the Eastern Orthodox communion, are generally grouped with this division.

The largest of the Protestant sects resulting from the Reformation begun by Luther in 1517 is the Lutheran church. It claims over 80,000,000 adherents, about two-thirds of whom live in Germany and Scandinavia. Methodists, Presbyterians, Anglicans (including the Protestant Episcopalians of the United States), and Baptists follow. Other numerically important denominations are the Disciples of Christ (Campbellites), Congregationalists, Mennonites, Friends (Quakers), Unitarians, and the Latter Day Saints (Mormons).

With the exception of the Lutherans the greater part of these Protestant denominations are found in English-speaking countries. One of the most remarkable recent religious movements is the growth of the Christian Science church, founded in Boston by Mrs. Mary Baker Eddy.

In recent years lines between sects are tending to be less distinct, and there is an increasing spirit of coöperation. Efforts are being made to combine denominations that are not far apart, as the Congregationalists and the Presbyterians.

THE "SHAKESPEARE OF PAINTING"

This portrait of Rembrandt painted by himself mirrors the face of one who loved life through and through, from its gallant outward shows to its inner spiritual depths.

REMBRANDT (*rĕm'brănt*) (1606–1669). When Shakespeare had but ten years more to live, there was born in Leyden, Holland, a boy who was to become one of the greatest painters of all times. Just as the great English dramatist could make a truth live through the reality of the men and women in his plays, so the artist Rembrandt—Rembrandt Harmenszoon Van Rijn, to give him his full name—painted men and women so that they seem as alive now as they were 300 years ago.

Rembrandt's father, who was a miller, intended him for a learned profession, but the boy showed so little interest in ordinary studies that they allowed him to follow his own bent—painting. He studied with artists in Leyden and Amsterdam. All his early work showed his intense desire to learn to represent the

lines, light and shade, and color of the people he saw about him. He made studies of every sort of person to be seen in the crowded streets. Jewish beggars and venerable rabbis, prosperous merchants, soldiers, cripples were his subjects. When he had no one else, he used himself as a model. It is estimated that he painted between 50 and 60 portraits of himself, not through any sort of vanity, but because he could use his own face as a mirror of all feelings.

In 1631 Rembrandt's work had become so well known that he moved to Amsterdam. Numerous orders for portraits were given to him as the foremost portrait painter of the day. The beautiful fair-haired Saskia Van Uylenborch, whom he married in 1634, was the model for many of his more fanciful pictures. In addition to portraits and set pieces, Rembrandt attained fame for his landscapes, while as an etcher he ranks among the foremost of all times.

It is impossible to describe the 700 pictures that Rembrandt produced, of which about 500 remain. There is one, however, which shows his powers so well that an appreciation of its excellence opens the eyes to an appreciation of all his work. That one is called 'The Night Watch' and is in the Royal Museum of Amsterdam. It is a life-sized picture of a group of 29 city guardsmen issuing for a sortie. Each man is painted with the loving care that Rembrandt gave to single portraits, and yet the composition is so wonderful that the separate figures are made second in interest to the effect of the whole. The canvas is brilliant with color, movement, and light. In the foreground are two men, one in bright yellow and the other in black. Rembrandt knew how to let the shadow of the one tone down the high light of the other. In the center of the painting is a little girl dressed in yellow. Many people wonder what she is doing all alone in that crowd of men. Joseph Israels, the great Dutch artist, says: "If Rembrandt could have heard them he would have answered with a laugh, 'Don't you see that I only wanted this child as a focus for the light and a contrast with all the downward lines and dark colors?' "

During the later years of his life Rembrandt lost some of his popularity. This was due to many reasons. The Thirty Years' War had impoverished all northern Europe, and pictures and portraits more than ever were luxuries. Many people objected to his free, independent method of work, and to his subjects. They thought that he should follow after the painters of Italy, that he should paint subjects from the history and mythology of Greece and Rome instead of from Dutch themes. Then, too, Rembrandt displeased many staid burghers by his extravagance in buying pictures of other artists. His vast collection of paintings was sold at auction before his death and he died poor and obscure. But for us he remains, as Israels says, "the true type of artist, free, untrammeled by traditions." His fame increases from year to year and his paintings are becoming almost priceless.

Besides 'The Night Watch', some of Rembrandt's chief works are: 'Marriage of Samson' and 'Wedding Breakfast' (Dresden Gallery); 'Saint Paul in Prison' (Stuttgart); portrait of his brother (Berlin); 'School of Anatomy' (The Hague); 'Syndics of the Cloth Hall', and 'Jewish Bride' (Amsterdam); 'Pilgrims at Emmaus' (Louvre); 'Family Group' (Brunswick); 'Portrait of a Man' (Windsor Castle); portrait of himself (Buckingham Palace). There are a number of Rembrandts in America in museums and private collections, among them 'The Mill' in the Widener collection in Philadelphia, and 'Girl at a Window' in the Art Institute in Chicago.

The DAWNING *of Our* MODERN AGE *in* EUROPE

How the Middle Ages Ended with the Recovery of Ancient Civilization and How Europeans Began Their Expansion Over the World

RENAISSANCE (*rĕn-ā-sāns'*). In a narrow sense, the term Renaissance (meaning "rebirth") refers to the revival, in the 14th and 15th centuries, of Greek and Roman culture. Historians formerly drew a sharp contrast between the so-called "darkness" of the Middle Ages and the brilliance of the Renaissance, when Europe was supposed to have become quickly enlightened by the recovery of classical civilization (*see* Feudalism; Middle Ages). It is now known that the change from the Middle Ages to the Renaissance was gradual and less important than historians formerly believed. It is also recognized that there were in operation many important forces besides the revival of classical culture. Nevertheless, the fuller appreciation of the writings, the arts, and the attitudes of mind of the Greeks and the Romans is still viewed as perhaps the most distinctive feature of the period. And so the first concern of this article must be with the revival of ancient culture.

Dante (1265–1321), who wrote his soul-stirring 'Divine Comedy' in Italian instead of Latin, was "the glimmer of the dawn" of the Renaissance.

Francesco Petrarch (1304–1374) was its real initiator in the field of literature and learning. He not only wrote many exquisite sonnets in Italian, but he "aroused classical antiquity from its long winter sleep," and gave direction to the talents of a hundred others. Like Dante he was a citizen of Florence, that wonderful city on the river Arno, the Athens of Italy; but both spent most of their lives in enforced or voluntary exile. The "Laura" to whom Petrarch's sonnets were addressed was a lady of Avignon, France, whose memory he faithfully cherished for many years after she was carried off by the Black Death in 1348.

There is a charming story of the lad Petrarch poring over half-understood books of Latin rhetoric and poetry to the neglect of his study of the Roman law. His angry father, after throwing the forbidden

volumes into the fire, relented and allowed the boy to save his favorites, Vergil and Cicero, half-burned from the flames. Another story tells how Petrarch in later life carried everywhere with him a manuscript copy of Homer's poems, hoping always that he might find someone who could teach him enough Greek to explore that hidden world.

To only two men since his day—Erasmus in the 16th century and Voltaire in the 18th—has it been given to wield an intellectual empire over Europe so universal as was the lot of this poet-scholar of the early Renaissance.

To the studies of Petrarch and his followers, as distinguished from scholastic philosophy and theology, the name *litterae humaniores* ("more humane letters") was given. From this we derive our term "humanists" for such scholars. Classical literature not only supplied them with standards of better literary form. It disclosed "a new conception of life; a conception freer, larger, more rational, and more joyous than the medieval; one which gave unfettered scope to the play of the human feelings, to the sense of beauty, and to all the activities of the intellect."

Boccaccio, "Father of Italian Prose"

Today Petrarch's friend and fellow townsman, Giovanni Boccaccio (1313–1375), is chiefly known for his witty stories, entitled the 'Decameron', which won for him the name "father of Italian prose" (*see* Italian Literature). But even more important was his part in carrying on the revival of learning. For Boccaccio was the first Italian in seven centuries to learn to read classical Greek. In addition he wrote many Latin works of scholarship which aided in the search for and identification of the lost writings of ancient literature. Soon hundreds of eager scholars were engaged in the work of spreading abroad the "new learning," with all sorts of unsettling results.

Princes, churchmen, and nobles in Italy now gave to literature and art the attention which north of the Alps was bestowed upon the stables and kennels; and the place of the knight errant was taken by the wandering humanist, who sought manuscripts as the former had sought adventures.

And how much of real romance is packed into the history of that quest! Over 700 ancient Latin writers are known to us by name, but the works of less than a fifth of these have survived even in part. There are only 43 writers of whose works we possess the major portion.

That we have so much is due to the tireless efforts of men like Petrarch and Boccaccio; of Niccolo de' Niccoli, the collector whose 800 manuscripts form the nucleus of the Florentine library; of Poggio Bracciolini, who had great success in the monasteries of Switzerland; of Nicholas V, the first humanist pope; and of a host of others who, before the age of printing, rescued from the neglect of the Middle Ages the priceless works of the ancient Greek and Latin authors.

"The arts and the inventions, the knowledge and the books, which suddenly became vital at the time of the Renaissance," says the English author, J. A. Symonds, "had long lain neglected on the shores of the Dead Sea which we call the Middle Ages. It was not their discovery which caused the Renaissance; but it was the intellectual energy, the spontaneous outburst of intelligence, which enabled mankind at that moment to make use of them."

Two agencies chiefly helped to spread the Renaissance beyond the Alps, gave it a Christian instead of a pagan character, and made it a contributing factor to the religious Reformation. The invention of printing, about 1450, was one of these (*see* Printing); Erasmus of Rotterdam (1466?–1536) was the other.

Charles Reade's 'Cloister and the Hearth' tells the story—largely by means of Erasmus' own writings—of the unhappy parentage of this great Dutch scholar. Born an illegitimate child and thrust into a monastery while still a mere boy, he became by his brilliant talents the protegé of princes and prelates. He spent his manhood in furthering the revival of Greek and Latin learning in France, England, Switzerland, and Germany—"wherever there were friends, books, and a printing press."

His 'Handbook of a Christian Soldier' was a manual of practical piety which ran through edition after edition. His 'Praise of Folly' (*Encomium Moriae*), written in England, while resting in the house of his friend Sir Thomas More after a visit to Italy, set all Europe to laughing at the hair-splitting subtleties of theologians, the slavish ceremonies of the monks, the ignorance and superstitions of the people, the luxury and neglect of duty by the heads of church and state. On the other hand his printed edition of the Greek New Testament (1516), and his editions of the writings of the early church fathers, laid the foundations for a sounder biblical theology.

Scores of scholars north of the Alps worked to the same ends; and the newly founded German universities, and the magic art of printing, carried the seeds of this Christian revival of learning far and wide over western Europe.

Revival of the Fine Arts

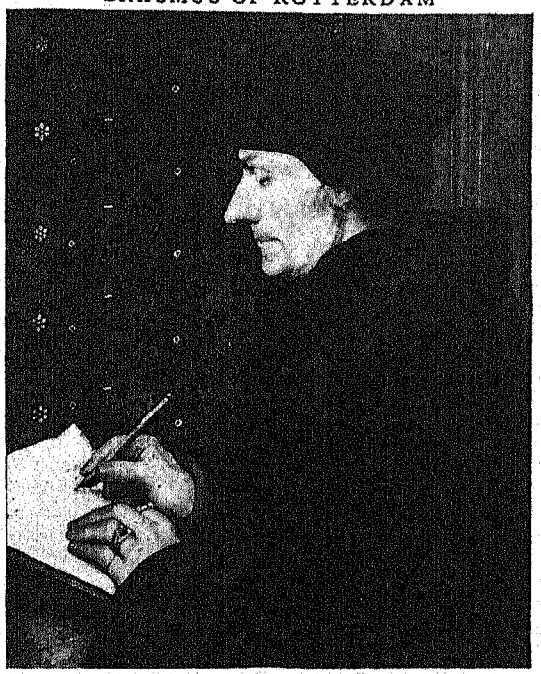
Parallel to this awakening of the human intellect was a great development of the fine arts. After centuries of stiff symbolic representation, artists began again to study nature herself and to work from the living model. New ideas of grace, harmony, and beauty were gained from the sculpture and other artistic remains of classical Greece and Rome. Presently came the discovery of better technical methods of execution—of the laws of perspective and the process of painting in oils. The result was that the art of painting burst into a glory previously unknown, and sculpture and architecture rivaled the grandeur of the ancient days.

As in the revival of learning, Italy again led the way, though the countries beyond the Alps soon followed. The dawn of the new age came with the sculptors Nicholas, John, and Andrew of Pisa. Contemporary with them was Giotto of Florence (1276–1336)—

sculptor, architect, painter, and friend of Dante. Ghiberti, Donatello, and Della Robbia—the latter the creator of the charming medallions of children in glazed terra cotta—continued the work in sculpture; Fra Filippo Lippi, Botticelli, Ghirlandaio, and Perugino in painting; and Brunelleschi and Bramante in architecture. The tumultuous exuberance of Gothic art gave way to the serene and rational beauty of the classic orders, the pointed arches to rounded Roman ones, the aspiration of vertical lines to the restful calm of the horizontal. St. Peter's in Rome sums up in itself the spirit of Renaissance architecture.

The full flowering of Renaissance art came in the late 15th and early 16th centuries, with Raphael, the prince of painters, Leonardo da Vinci, and Michelangelo, embodiments of supreme many-sided genius. With these flourished the lesser lights—Andrea del Sarto, "the faultless painter"; Correggio, who depicts Christian saints with pagan charm and beauty; Titian, the superb master of Venetian colorists; and Tintoretto, a master of technique.

ERASMUS OF ROTTERDAM



The profound scholar and witty satirist Desiderius Erasmus was the greatest figure of the Renaissance in the lands that lay north of the Alps. This splendid portrait of him by Hans Holbein hangs in the Louvre, Paris.

North of the Alps—in Flanders, Holland, and Germany—the chief names are the brothers Van Eyck, to whom is ascribed an important part in developing oil painting, Albrecht Dürer and Hans Holbein, each of whom is connected with the new art of printed engraving as well as painting. The greatest of northern painters—Rubens and Rembrandt—belong to the period following the Renaissance.

The Later Renaissance

In any great movement, sooner or later enthusiasm begins to wane. The study of Latin and Greek, which, to the humanists, was a method of getting at the kernel of classical culture, became formalized into an uninspiring routine discipline. Many writers became mere imitators of the ancients. Art degenerated into such extravagances as baroque sculpture and architecture. Individualism often became a mere cloak for unclassical lack of moderation and self-discipline. Rulers often adopted the view that the end justified the means, and the end was likely to be a selfish exercise of power. Such views are called Machiavellian, from Machiavelli of Florence (1469–1527), author of 'The Prince', a book on statecraft. All this and more may be said in criticism of the late Renaissance; yet, the inspiration derived from humanism has continued to our own time.

In the early modern age, the creative spirit found expression in many ways—in the writings of Rabelais, Cervantes, and Shakespeare; in the music of Palestrina; in the invention of the operatic form of music; in the perfection of the violin by the master-craftsmen of Cremona; in the introduction of three of the greatest inventions of all time—the compass, gunpowder, and the printing press; in the work of the scientists, such as Copernicus, Vesalius, and Galileo; in the formation of strong central governments; in the building of cities; in the reorganization of business; in the adventurous voyages of Diaz, Vasco da Gama, Columbus, and Magellan; and in the marvelous energy displayed by Europeans in carrying their civilization to all parts of the world.

Town Life Before the Renaissance

Greek and Roman civilization was a civilization of towns and city-states. The people of the Middle Ages were overwhelmingly agricultural. In a broad sense, the Renaissance included a revival of town life, with its diversified industries and interests, no less than a rebirth of ancient literature and art.

Long before the 14th century, towns flourished in nearly every section of Europe. They arose in various ways. The earliest towns were places of refuge and defense: the word "town" comes from the Anglo-Saxon *tun*, a fortified place. Castles, monasteries, cathedrals, and fortresses were sometimes located at the crossroads of leading highways, near well-protected harbors, or at a break in a stream. If a site combined the advantages of protection and of trade, a market or a fair was likely to be established there, and a town would grow up. Merchants of a particular town usually formed an association or "merchant gild." Traders and members of their families at these places often had leisure to manufacture goods, which they offered for sale at the markets. When they came to think of themselves more as craftsmen than as traders, they formed craft gilds, such as the gilds of "the butchers, the bakers, the candlestick makers," and many others. Gilds were partly social organizations, like the clubs and fraternities of today. Their main purposes were to protect their members from land-

lords and rival merchants and craftsmen of other towns, and to regulate the making and selling of goods so as to maintain standards and to prevent abuses. (*See* Gilds.)

Growth of Towns

Towns grew up very slowly. For defense they were surrounded by stone walls. Narrow streets wound around a hillside, or about a castle or cathedral, or along a shore line of a harbor. Upper stories of buildings were often built out over a street below, to save space, for space within the protecting wall was precious. Industrial life was conducted along very simple lines. A shoemaker, for example, bought his leather in the weekly market, took orders from his customers, and made the shoes and sold them in the front of his house, and used the rear or an upper floor as a dwelling.

In larger places, townsmen gradually secured privileges, such as the right to pay a town tax instead of rendering individual services to a lord, and the right to have their own town government. Most towns were little more than villages. As late as 1250, London probably had only about 25,000 people; the two towns next in size, York and Bristol, each about 10,000; and most of the towns of England, from 1,500 to 4,000. In places on the Continent, and especially in Italy, in southern France, on the Rhine River, and in parts of the Netherlands, towns were much larger and more influential than in England, but even in these regions, the great revival of town life and the general expansion of trade beyond local limits were distinctive features of the age of the Renaissance.

When merchants attempted to carry on trade beyond the interchange of goods between local villages, towns, and markets, they met many difficulties. Gilds, which were organized for purely local trade, were usually hostile to outsiders. Londoners, for example, were regarded as foreigners at Bristol. The disorder of the long-continued invasions was followed by almost constant fighting between the feudal lords. Rulers were interested not so much in encouraging trade as in exacting tolls and taxes. There were few good roads and bridges, and only a small number of lighthouses or other aids to navigation. Goods were carried mostly by pack-horse, sailboat, and rowboat. Geographical ideas were vague and commonly erroneous. Storms, floods, fires, pestilences, and other "acts of God" were dreaded less than the acts of "robber barons" and of pirates. There was no dependable system of money. Credit was little used, and weights and measures as well as coinages were matters of local arrangement. Added to all these difficulties, crude methods of production and transportation limited the available surplus of goods for sale.

Europeans Find Ways to Trade in Distant Lands

In view of these conditions, there was a remarkable growth of towns and expansion of trade in the 14th and 15th centuries. The first, or medieval, phase of this expansion was connected with the Crusades. Knowledge of new goods and of new opportunities for trade and adventure stimulated a keen desire that, in turn, resulted in the finding of methods to overcome obstacles in the way of distant trading. (*See* Crusades.)

Gilds and town markets were merely local. How did goods from one region find their way to other parts of Europe or to more distant countries? An old English law refers to "pedlars, tynkers, and petye chapmen." These men visited markets and fairs and went about the country in large numbers, selling such goods as "pynnes, poyntes, laces, gloves, knyves, glasses, and tapes." They were "a jovial race," seeking success "through fair speech and enticing words."

In addition to "petty chapmen," there were regular merchants and their agents, many of whom not only visited the principal fairs and towns in their own countries, but also bought and sold in the marts of distant places. They often acquired considerable wealth, became widely acquainted, and by interchange of ideas and customs built up a set of practises known as the "law merchant" for regulating trade throughout Europe. Fairs held once or twice a year sometimes attracted merchants from many different regions. Transactions at fairs as well as trade by sea came under the regulations of the law merchant.

Start of Banking Systems

Some of the wealthier merchants were also bankers. They loaned money to landlords and rulers as well as to business men, and found ways to overcome the medieval objections to interest, or usury. They bought and sold at a profit different kinds of coins—a business called "money changing." They came to be so well known not only at home but also in other parts of Europe that they often acted as agents in handling accounts as well as goods. If A in Germany owed B in Italy for a consignment of goods sent north, and if C in Italy owed D in Germany for goods sent south, credit arrangements resembling modern bills of exchange were handled by bankers such as the Fuggers of Augsburg or the Medici of Florence, so that it was not necessary to send much cash back and forth. The bankers introduced, in a crude form, the writing of insurance policies. Their notes and credit papers were so widely recognized that they circulated to some extent as money. Thus, in the early expansion of trade, were the beginnings of our financial system.

Merchants had little protection from robbers, pirates, and other hazards of travel. Partly for protection and partly for companionship, they traveled in groups, employed guards, and sent out their armed boats in fleets. Many associations or companies were formed for a single voyage or particular occasion. In some cases, permanent groups or corporations were formed. In England, for instance, the Merchants of the Staple handled staple goods, such as wool, tin, leather, and lead, and were required to ship them from certain "staple" towns in England to a "staple" town on the Continent. Later, the Company of Merchant Adventurers was formed to deal more largely in manufactured goods, especially woolens, which Englishmen were beginning to make for the markets in the 15th century.

These companies received charters of incorporation, with various rights and powers. They were "associated" or "regulated" companies; the members carried on trade on their own accounts, with the protection and the regulations of the company. First in Italy, and later in other countries, some of these groups became joint-stock companies. The selling of pieces of paper representing shares of ownership and interest in an enterprise has come to be the principal method of financing business undertakings.

In Venice and some other cities, ships were owned and operated by the town governments. These governments also sent out consuls, established trading centers, and made treaties. There were leagues of governments. Of these the most famous was the Hanseatic League of North German cities. It served in place of a strong central government such as existed in England. (*See* Hanseatic League.) In Western Europe, powerful central governments were growing up, and when trade shifted westward in the 16th century, not town but national governments formed the political basis for commercial and colonial expansion.

Europe Faces Westward

Trade expansion first extended merely to the exchange of goods between adjacent regions, as, for example, wool from England to Flanders, and woolens from Flanders to England. By the 14th century, Europeans were trading, indirectly, with countries as far away as India, China, and the Spice Islands. Italians, especially Venetians, sent fleets to ports of the eastern Mediterranean. Here they secured spices, gems, drugs, and finely fabricated goods from age-old oriental workshops. These goods, collected in oriental markets, bazaars, and fairs, were carried westward by successive groups of merchants, either overland in caravans or by sea to the Isthmus of Suez, or partly by land and partly by water by way of the Persian Gulf and the Tigris-Euphrates river valleys. (For medieval trade routes *see* map with Commerce.)

In the 14th century, the writings of Ptolemy, a great ancient geographer, had been recovered. Ptolemy had suggested that one would reach India by sailing westward. Columbus had a copy of Ptolemy's geography. Many other navigators believed that the earth was a sphere; and before Columbus tried to carry out his idea of sailing westward to India, the Portuguese took the lead in western explorations (*see* Henry the Navigator). Early in the 15th century, they occupied several of the western islands, advanced beyond the desert of Sahara, and opened up the slave trade. They employed many Italians, who were skilled in shipbuilding, map making, the use of the compass, and the art of navigation. By means of these Italians, they seemed on the point of breaking down the monopoly of the Italian cities in the Far Eastern trade, for they gradually extended their influence southward along the islands and the mainland till by 1488 Diaz had rounded the Cape of Good Hope. However, some explorers, including Columbus, still believed that the simplest way to reach India was by sailing directly westward. When Columbus returned from his first voyage of 1492, it was generally believed that he had discovered, not a new world, but a new route to the old world of eastern Asia. The Portuguese then redoubled their efforts, and in 1498 Vasco da Gama succeeded in reaching India by sailing around Africa.

The immediate results of the great discoveries included the breakdown of Italian and German trade; the transfer of trading centers, wealth, and power to the Atlantic seaboard; the rise of the Portuguese and Spanish empires; and the almost unbelievable stirring up of the sluggish minds and ambitions of Western Europeans. Out of the twofold stimulus of the recovery of ancient culture and the discovery of the nature and limits of the world's geography, came most of the distinctive ways of thought and of life that make our age different from earlier ages.

—REFERENCE-OUTLINE *for Organized Study of* THE RENAISSANCE *and* THE REFORMATION—

IT IS a mistake to think of the Middle Ages as a dark, dull period suddenly ended by the Renaissance. After the Barbarians wrecked the ancient world, Europe began a slow march of about a thousand years, back to order, knowledge, and culture. Then the horizon of the civilized world was greatly enlarged by the invention of printing, the mariner's compass, and the discovery of America. The use of gunpowder brought a social revolution in its train. New ideas about the physical world and about man were followed by new ideas about God. The religious Reformation established Protestantism. And finally the change from the medieval dream to the realistic attitude of science laid the foundation for our modern world.

I. FORERUNNERS AND CONTRIBUTING CAUSES:

A. Influence of Crusades: M-160, A-141, C-406.
B. Desire for Eastern Trade: A-142, R-77, C-276.
C. New Inventions: R-74, E-172, C-247, P-347, E-164, G-188, C-325.
D. Growth of the Creative Impulse: R-74–5, A-267.
E. Fall of Constantinople: C-345.

II. THE RENAISSANCE IN LITERATURE:

A. Causes and Development in Italy:
  a. Early Prosperity of Italian Cities: A-141, R-77, V-278–9, S-249.
  b. Florence, Center of Culture: F-107, M-107.
  c. Rediscovery of Classics: R-73–4, A-141, E-173–4.
  d. A New Literary Language: F-108, I-152. Dante R-73, D-10; Petrarch R-73–4, E-173; Boccaccio R-74, B-153.

B. North of the Alps: Erasmus R-65, E-284; Printing P-346; Universities E-171–2.
  a. In France: F-209, F-196, M-242, R-9.
  b. In England: E-283, C-158, M-257.

III. THE RENAISSANCE IN THE ARTS: (*See also* Reference-Outlines for Architecture, Painting, Sculpture.)

A. Italy's Response to Classic Influence: R-74–5, S-56.
  a. In Architecture: A-270.
  b. Sculpture an Independent Art: S-56–8.

c. Highest Development in Painting: P-15–16.
d. Church Patronage of Art: J-228, L-98, M-107.
B. Great Painters of the North: P-16–18, D-120, H-318.
C. Baroque Styles: A-270, S-59.

IV. BEGINNINGS OF MODERN SCIENCE:
A. Advances in Astronomy: C-247. Copernicus A-341, C-356; Galileo G-1, G-142, M-156, T-38.
B. Development of Medicine Through Study of Anatomy: Vesalius A-191; Harvey I-112, B-158.

V. EXPLORATIONS AND DISCOVERIES: (*See also* Reference-Outlines for Geography, United States History, and for each continent.)
A. New Ideas of Geography: R-77, C-247, G-34.
a. In Navigation: A-142, N-49, C-326.
b. Changes in Commerce: A-142, S-319.
B. The Rise of Spain and Portugal: R-77, S-249.
a. Prince Henry the Navigator: H-280. Diaz C-80; Vasco da Gama G-3; Magellan M-27, A-144.
b. Columbus Discovers America: C-316, A-142.

VI. ECONOMIC AND POLITICAL CHANGES: (*See also* Reference-Outline for Economics.)
A. Modern Economic Life: A-142. Town Life R-76; Financial System B-43, R-76, C-371.
B. Powerful Central Governments: E-323.

VII. THE REFORMATION BEGINS IN GERMANY:
A. Forerunners: R-65, C-232. Wyclif W-191; John Huss H-363; Erasmus R-74, R-65.
B. Reformation in Germany: C-232, G-72. Luther L-220, R-65; Peace of Augsburg R-66.

VIII. SPAIN CHECKS REFORMATION: Charles V C-146, S-230; Foreign Distractions F-186, E-323, C-147, R-66; Revolt of Netherlands P-163, N-70, W-103.

IX. CALVINISM AND ITS ALLIES:
A. In Switzerland: C-35, C-232, R-66. Zwingli Z-232.
B. Huguenots in France: H-354, C-233, R-106. Persecutions C-300, C-152; Edict of Nantes H-279.
C. In Scotland: S-46. Knox K-37; Mary Stuart M-74.

X. REFORMATION IN ENGLAND:
A. Henry VIII's Break with Pope: H-278, W-130, C-233. Doctrinal Changes H-278, E-190.
B. Catholic Reaction: M-73, C-233, G-178.
C. England the Great Protestant Power: E-254, C-233. Defeat of Spanish Armada A-300, D-90, P-163; Elizabethan Age E-284, N-181; Shakespeare S-94; Bacon B-10.

XI. COUNTER-REFORMATION:
A. Early Reformers: Savonarola S-32; Ximenes X-197.
B. Work of the Inquisition: I-80.
C. Within the Church: R-67. Loyola L-211; Xavier X-197.

XII. THE THIRTY YEARS' WAR:
A. Last Great Religious War: T-80. Gustavus Adolphus G-189, A-308; Richelieu R-106.
B. Results: Religious T-81, E-323; Devastation T-80; Political Adjustments E-323.

(*See also* Reference-Outlines for **Middle Ages, Europe,** and for important European countries.)

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Smith, Preserved. Age of the Reformation (Holt, 1920).

REPTILES. The "creeping creatures" that we call reptiles—the tortoises, crocodiles and alligators, lizards and snakes—have an exceedingly ancient and important history. Some millions of years ago their ancestors ruled the earth. Among those ancient reptiles were the largest land monsters that ever lived—the dinosaurs (*see* Animals, Prehistoric). Among them also were the ancestors of the birds and the mammals. At the other end of the chain, the reptiles are believed to have developed from the "amphibians" or "batrachians," of which frogs, toads, newts, and salamanders are the modern representatives; and these, in turn, probably developed from the fishes. Thus reptiles occupy a central position in the evolution of vertebrate or "backboned" animals.

Today the reptile class has fallen from its high estate. With the exception of certain groups of snakes, the reptiles as a whole appear to be degenerating and dying off. They have been greatly reduced in numbers as well as in size, the crocodile being the largest living representative of the class. Science describes a reptile as a cold-blooded lung-breathing creature, with a scaly skin, whose skull is connected by a single bone-end or condyle. More than 20 groups flourished in the "Age of Reptiles," whereas but four groups now remain. One of these has but a single living species, the tuatara (*Sphenodon*) of New Zealand, a unique survivor from prehistoric days (*see* Lizards). Scientific names of living orders of reptiles: Turtles and tortoises, *Chelonia;* crocodiles, alligators, and gavials, *Crocodilia;* lizards and snakes, *Squamata;* tuataras, *Rhynchocephalia.* The chief extinct orders of reptiles were the dinosaurs, land monsters; the plesiosaurs, aquatic, with long necks and paddle feet; the ichthyosaurs, whale-shaped sea dwellers; and the flying pterosaurs.

RESINS. The most common resin, known as "rosin," is that obtained from the distillation of the sap or crude turpentine of the long-leaf pine of the southeastern United States. It is largely used in paints and varnishes and in the making of laundry soap and sealing wax, and to rub on the strings of violin bows to keep them from slipping. Among mixtures of gums and resins are the malodorous asafoetida, which is the dried and milky juice of the roots of certain plants of western Asia; gamboge, the brownish resin obtained from these plants in Cochin-China and Siam used as a yellow pigment and sometimes in medicine; myrrh, the fragrant resin of several plants in Arabia and Ethiopia, which is so largely used in the manufacture of incense and perfumery and also in medicine. The "dammar" resins from several different coniferous trees of India, New Zealand, Australia, and the East Indies are widely used in making varnish. Amber is really a fossil resin (*see* Amber).

Synthetic plastics made from formaldehyde and carbolic acid or other chemicals, and also those made from cellulose, are sometimes called "resins," or "synthetic resins." They resemble natural resins in plasticity, but not in chemical nature.

BREATHING, *the Mainstay of* ALL LIFE

RESPIRATION. All living things need oxygen just as much as they need food. Without oxygen, the food they take in would be useless to them and they would die. With oxygen, they are able to burn the carbon in their food, and the heat of the burning yields the energy that gives them the power to grow and move. In the burning, the oxygen combines with the carbon and forms carbon dioxide as a waste. The way living things get oxygen, use it, and get rid of carbon dioxide is the story of respiration.

HOW A FISH BREATHES

Water is drawn into the mouth and forced through the gill fringes shown above, which absorb the dissolved oxygen; then it passes out again through the gill slit.

The tiny one-celled animals and plants (like amoebas and bacteria) simply take oxygen in through cell walls and expel carbon dioxide in the same way. Among the larger living things the methods of respiration differ widely. Trees breathe through tiny holes in their leaves (*see* Plant Life). Insects breathe through fine tubes in the joints of their abdomens (*see* Insects). Earthworms breathe through their skins. Fish breathe through gills (*see* Fish). Reptiles, birds, and mammals breathe through lungs (*see* Lungs). Amphibians, such as the frog and the salamander, breathe through gills in their larval or tadpole stage and through lungs in adult life (*see* Frog; Salamander).

Most living things get their oxygen from the air. Some, which are cut off from the air, get their oxygen out of other substances. The yeast cell, buried in bread dough or in a fermenting liquid, breaks up the sugars or starches that surround it to get the oxygen it needs. The carbon dioxide given off by the "breathing" yeast causes the bubbles we see in fermenting liquids (*see* Yeast).

The larger living things need a transportation system to carry the oxygen to every one of their cells and to carry the carbon dioxide away. In plants, this is done by the sap. In the higher animals, the oxygen and the carbon dioxide are circulated by the blood (*see* Blood; Heart).

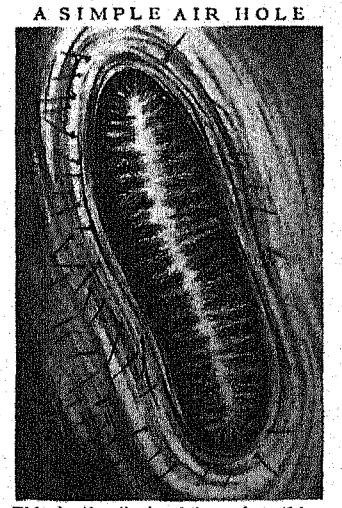
Man's Breathing Habits

We breathe by first taking air into the lungs (*inspiration*) and then expelling it from them (*expiration*). These two acts make up a *breath*.

An adult normally takes about 16 breaths a minute when awake and about 6 to 8 when asleep. But under stress, he may take as many as a hundred a minute. In a normal breath the average man takes in about one pint of air or approximately 30 cubic inches. The most he can inhale in one breath is about seven pints. No matter how hard he blows his breath out, he cannot empty his lungs. They will still contain about one quart of air.

After taking a single deep inspiration, the average person may not be able to hold his breath for more than 30 to 60 seconds. But if he carries on deep, forced breathing for a minute or two beforehand, he can increase the span. Before diving equipment came into general use, pearl and sponge divers often stayed under water four minutes or more.

A SIMPLE AIR HOLE



This is the "spiracle" or breathing pore of a silkworm. It leads into the air tubes that take the place of the gills of fish or the lungs of warm-blooded animals.

The Machinery of Breathing

To understand the machinery of breathing, we must know something about the airtight "box" called the chest cavity. The top and sides of the box are formed by the ribs and attached muscles; the bottom, by the dome-shaped muscular partition called the diaphragm (*see* Diaphragm). Inside the box lie the two lungs and the heart. The only openings are those through which pass the blood vessels, nerve cables, and windpipe. A partition running from front to back surrounds the heart and divides the lungs from one another. Each lung completely fills its compartment.

This entire box can expand or contract, somewhat like an accordion. This is accomplished in two ways. The rib muscles can pull the ribs up and outward or let them move down and inward. The diaphragm, in turn, can rise or fall.

When we breathe in, the rib muscles elevate the ribs and the diaphragm pushes downward. So the chest cavity grows larger. Immediately the air pressure in the lungs is reduced, and air flows into them.

When we breathe out, the rib muscles and the diaphragm relax and the chest cavity grows smaller. The lungs, which have been stretched by the incoming air, now contract elastically and grow smaller with the chest cavity. Thus air is forced out of the lungs.

The nose filters, moistens, and warms the incoming air to condition it for the delicate membranes of the lungs. Bristle hairs in the nostrils and sticky mucus

on the nasal membranes intercept particles of dust from the air. On the nasal membranes, tiny hairs called *cilia* beat outward ceaselessly and whip countless particles of dust back toward the nostrils.

What Happens to the Oxygen

Breathing is only the beginning of our story of respiration. Let us see what happens to the oxygen after it has entered the lungs with a breath of air.

The article on Lungs explains their remarkable inner structure of tubes and air sacs, and tells how the oxygen passes from the air sacs into the blood stream. The article on Blood shows how the red blood corpuscles manage to carry the oxygen to every cell of the body. Now we come to the climax of all these events. The oxygen breaks up certain carbon compounds contained in the cell, and then unites with the carbon to form carbon dioxide. This reaction is a kind of burning or combustion (*see* Fire). It releases energy needed for the activities of the body in much the same way as the burning of a mixture of air and gasoline vapor produces the power that drives an automobile.

(The oxygen usually acts *indirectly* upon the so-called body fuels. When a muscle exerts itself, for example, the chemical reaction is as follows: The muscle fuel called glycogen ($C_6H_{10}O_5$) unites with some of the water in the tissues (H_2O) to form lactic acid ($C_3H_6O_3$). The oxygen in the blood then reacts with *some* of the lactic acid to form carbon dioxide (CO_2) and water. The energy produced by this reaction is sufficient to turn the rest of the lactic acid back into glycogen, thus restoring the supply of muscle fuel.)

What Happens to the Carbon Dioxide

We have learned the fate of the oxygen and now we turn to the carbon dioxide that forms when oxygen and carbon unite in the body cells. The carbon dioxide passes out into the blood stream and goes to the lungs. Some passes into the air sacs of the lungs and our breathing expels it as a waste product. The rest stays in the blood and moves on to do the important job of controlling our breathing.

This job is carried on in the *respiratory center*, a cluster of nerve cells in the medulla oblongata at the base of the brain (*see* Brain; Nerves). The work of the carbon dioxide, passing through the respiratory center with the blood stream, is to stimulate the nerve cells located there so that they send out a constant stream of nerve impulses. These travel to the rib muscles and the diaphragm, stimulating them to work.

Increase the carbon dioxide in the blood ever so little, and the respiratory center sends out stronger nerve currents so that we breathe more rapidly and deeply. Decrease the carbon dioxide, and our breathing automatically slows down.

During severe exercise, the hard-working muscle cells give off large amounts of carbon dioxide into the blood, and we breathe very rapidly. Even *after* a race, an athlete continues to breathe rapidly for some time until the amount of carbon dioxide in his blood is reduced to normal.

How the Nerves Change Our Breathing

The respiratory center is connected with nearly all the sensory nerves of the body. Hence any stimulation of these nerves can change our breathing. A sharp pain makes us catch our breath. The act of swallowing stimulates a nerve in the back of the mouth which sends a message to the respiratory center; breathing stops for a moment so food won't get drawn into the windpipe. Irritation of the throat makes us cough. Irritation of the nasal passages makes us sneeze. Yawning, sighing, laughing, sobbing, and hiccoughing —all these involve changes in our normal breathing rhythm stimulated by nerve messages transmitted through the breathing center.

Our various acts of breathing are essentially reflex or automatic (*see* Reflexes). But often the conscious centers of the brain may "order" the respiratory center to change our breathing, as when we take deep breathing exercises or cut off a sneeze before it can disturb our neighbors.

Valuable "By-products" of Breathing

Breathing serves us in a number of special ways. For example, we owe our voices to breathing. The air we breathe out vibrates our vocal cords to produce the sounds of talking, singing, and laughter (*see* Voice). Also the movements of breathing help to circulate the lymph and the blood (*see* Blood).

Physicians often study a patient's breathing before making diagnoses. The rate of breathing, under controlled conditions, may disclose facts about the state of the heart and lungs. Listening through a stethoscope to the various sounds of breathing may reveal the presence of respiratory disorders such as pleurisy, bronchitis, pneumonia, or tuberculosis.

A test very commonly used in a general diagnosis is called the *basal metabolism test*. This is given in the following way. The patient, while completely at rest, breathes in and out through the tubes of an apparatus that measures exactly how much oxygen he takes in and how much carbon dioxide he exhales in a given time. From this can be determined the rate at which the patient regularly burns up his body fuels. The physician then compares the patient's rate with the normal rate as shown on charts. A rate above normal may indicate an overactive thyroid gland, for this gland stimulates the oxidation processes. A rate below normal may indicate an under active thyroid (*see* Gland).

Artificial Respiration

Breathing can stop completely for a time as a result of drowning, electric shock, or certain kinds of poisoning, with a fair chance of being started again by *artificial respiration*. When no mechanical devices are available, it can be applied by hand as pictured in the First Aid article. When infantile paralysis impairs the nerves that activate the muscles of breathing, artificial respiration may be applied continuously with a device called an "iron lung." (For facts about the effect on our health of the kind of air we breathe, consult the article on Hygiene.)

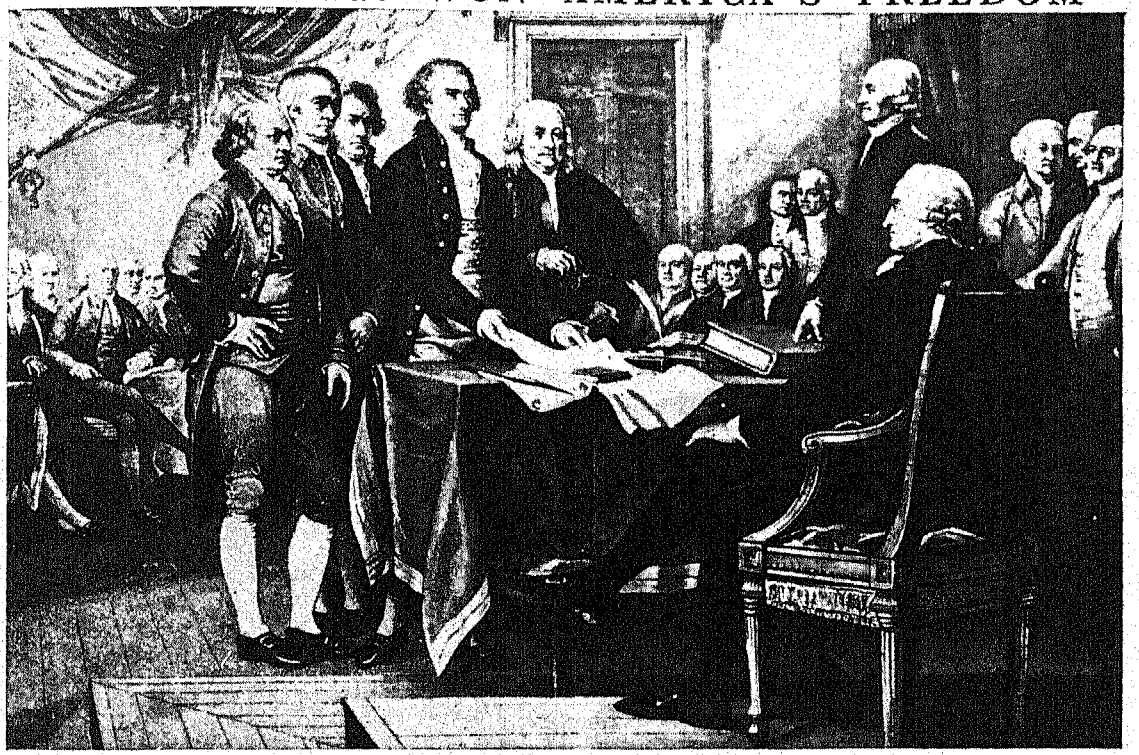
REVERE, PAUL (1735–1818). Paul Revere aided the cause of the colonies during the entire War of Independence, but most of us associate his name with his

famous ride from Boston to Lexington to warn the militia of the approach of the British soldiers.

Revere was a Boston goldsmith. He had been a member of the party that destroyed the tea in Boston harbor, and in 1775 was at the head of a committee to watch the movements of the British troops. When it was known on the night of April 18 that the latter intended to march to Concord, Revere "silently rowed to the Charlestown shore," where he waited for the signal light in "the North Church tower." As soon as he saw the signal, showing that the troops were actually on the way, he rode to Lexington, rousing the minutemen on his way. At Lexington he was captured by the British and held during the day, but a companion got through to Concord.

During the war Revere rose to the rank of lieutenant-colonel. He established a powder-mill for the colonists, and engraved the first Continental money.

The WAR *that* WON AMERICA'S FREEDOM



Will the Continental Congress adopt the Declaration of Independence? Thomas Jefferson presents the document to John Hancock, president of the Congress. In the committee that drafted it are, right to left, Benjamin Franklin, Jefferson, Robert Livingston, Roger Sherman, and John Adams. John Trumbull painted the original of this picture.

REVOLUTION, AMERICAN. Warned by prolonged rumblings of discontent from 13 of her American colonies, England in 1775 felt the shock of a revolution which finally severed her from her first great empire oversea. For seven years the skies of men's fortunes were darkened while the fate of self-government hung in the balance of the Old World and the New.

When the storm had passed, a strong impetus had been given to democracy throughout the world. Eventually the greater part of America broke loose from Europe and set out upon an independent course. The ordeal of war trained American leaders in the hard school of difficulty and danger, revealing those who were weak or unfit, and bringing forward those who could act bravely and think clearly. When the work of shaping the new republic was under way, there was little place for men who were found wanting.

The policies of England that led to the revolt of her 13 colonies grew out of the French and Indian War. In this conflict the American empire did not function effectively as a unit. Its organization was weak, and the colonists were prone to ignore orders from England and to act as pleased them best. They had not provided money and soldiers for the campaigns as readily as England desired. Some colonial merchants had carried on a forbidden trade with the French. Everywhere in America a strong spirit of independence had revealed itself, and the empire seemed on the verge of going to pieces. (*See* French and Indian War.) These difficulties had been foreseen by far-sighted leaders in England and America, and had led to the calling of the Albany Congress at Albany, N. Y., in 1754. Representatives of the seven colonies there discussed plans of unified action in relation to war and

the government of the colonies. Franklin drafted the proposals, but they were never made effective.

The Result of the French Wars

The treaty of 1763 ending this war made England master of Canada and the land between the Appalachian Mountains and the Mississippi River. The whole cost of governing this vast region was suddenly shifted from France to Britain. Yet the British people already staggered under an immense national debt, and their taxes were higher than ever before. In the view of British ministers, England had made great sacrifices in order to expel the French from Canada. The chief motive had been national advantage; but as one of the results the 13 colonies might now live in peace. The British prime minister in 1763 —George Grenville— did not understand the views of the colonists or concede that they had any real political rights. He thought now to place them in an imperial strait-jacket that they might become most profitable to England at the least expense.

FIRST NEWS OF THE STAMP ACT

Indignation blazes on every face as these Boston colonists listen to the reading of the hated Stamp Act just arrived from England. To one side is the royal custom-house, adorned with the crown and the initials of *Georgius Rex* ("George, King" in Latin). From Harold Rugg's 'A History of American Government and Culture' (Ginn).

Settlers were now pouring into the Ohio Valley, and land speculators were busy with schemes for opening the country won at so great a sacrifice from the French. Such activity excited the worst fears of the Indians. Land, fur-bearing animals, the redman's very existence—all would be engulfed by the remorseless advance of the whites. Fur traders were debauching the Indians with rum and cheating them of their furs. Up and down the western rivers traveled French agents who incited the tribes against the English, promising that a huge French army was on the way to recover the lost lands for the redman and France. Now there emerged a great chieftain, Pontiac, who united the tribes in 1763, and led them in a series of destructive raids on the advancing frontier.

Restriction of Westward Settlement

With the purpose of quieting the Indians, England issued the Proclamation of 1763, which forbade settlers to buy lands beyond a line running through the sources of the rivers flowing into the Atlantic. England, it seemed, meant to favor the Indians and the fur traders at the expense of the pioneer, the land speculator, and the colony whose charter gave it a claim to a section of the interior westward to the Mississippi River.

But the settlements east of the "Proclamation Line" were not to be neglected. For their defense England decided to station a large army on the frontier. Should the colonies contribute toward the expense of this protection? Yes, said England—and by paying taxes imposed by Parliament.

Trade offered one source of revenue. The old Molasses Act, having yielded but little income, was modified in 1764. The colonists now had to pay import duties on foreign molasses, sugar, wine, and other commodities. More important, measures were adopted to prevent smuggling. Revenue officers sought writs of assistance allowing them to search homes for smuggled goods, and James Otis gained fame in his flaming attack upon their use (*see* Otis, James). Since this new Sugar Act would not afford a large revenue, it was supplemented in 1765 by the Stamp Act (*see* Stamp Act). This levied a direct tax on all newspapers printed in the colonies, and on most commercial and legal documents used in business. It was realized that these two revenue acts would provide less than half the money needed for the army. Another measure—the Quartering Act—required each colony to bear part of the expenses incurred by the British troops when stationed or moving within its borders. The Currency Act of 1764 increased the load of taxes to be carried by the colonists, for it directed them to pay, within a fairly short time, the whole domestic debt which they had created for carrying on the French and Indian War.

The Outcry Against the Stamp Act

Opposition to the Stamp Act spread through the colonial assemblies, especially that of Virginia (*see* Henry, Patrick). It came to a head in the Stamp Act Congress of 1765, which asserted that the colonists, as English subjects, could not be taxed without their consent. Alarmed by the refusal of the colonial towns to buy additional goods while the act remained in force, British merchants petitioned Parliament for its repeal. Meanwhile, Grenville was succeeded by Lord Rockingham, a minister more friendly toward the colonists. In repealing the Stamp Act in 1766, Parliament at the same time declared that it had full power to tax the colonies whenever and however it thought best.

The Issue of Taxation

During the Stamp Act controversy a Maryland lawyer, Daniel Dulany, wrote that although Parliament might lay external taxes on the trade of the colonies, it

could not rightfully impose internal taxes to be collected directly from the people. This distinction became immensely popular at the time. When Charles Townshend was Chancellor of the British Exchequer he framed his famous revenue act of 1767 in line with the colonial view. Duties were placed on lead, paint, glass, paper, and tea, when imported into the colonies. The money collected was to be used to support British officials in the American service. Colonial opposition to these taxes was not foreseen.

But the colonists objected strenuously. Their leading spokesman this time was John Dickinson of Pennsylvania. In his widely read 'Letters of a Farmer in Pennsylvania', he made a new distinction —between taxes levied to regulate trade and those intended to raise a revenue. If the purpose was to promote imperial commerce, the tax was justifiable. But if England could levy taxes simply to obtain a revenue, the colonial rights of self-government would soon be at an end. Only through their power to withhold the salaries of British governors had the colonial assemblies been able to keep them in hand. If England should now pay such salaries from Parliamentary taxes, the governor—upon becoming independent of the assembly—would soon be able to squeeze it to the size of a pigmy and dwarf most of its activities.

BOSTON'S £15,000 TEA PARTY

"King George will never collect a tax on this tea," say these Boston colonists, disguised as Indians, as they haul the cargo from the hold of the East India Company tea ship and heave it overboard.

Tea and the "Tea Party"

In 1770, a new prime minister, Lord North, believing it unwise for England to hamper the sale of her own wares in outside markets, secured the repeal of most of the Townshend duties. At the request of King George III the duty on tea was left, in order to assert the right of England to tax the colonies. The American merchants accepted this compromise, and the agitation in the colonies soon died down. The remaining duty was evaded by smuggling: about nine-tenths of the tea imported after 1770 did not pay the odious tax. Then in 1773, Parliament passed another act that set all the elements of discord in motion. This allowed the British East India Company to ship tea to the colonies without paying any of the import duties collected in England. The Company, near the brink of bankruptcy, had on hand an immense quantity of unsold tea, which it could now sell more cheaply in the colonies than tea imported by local merchants, who had to pay the high duties in force in England. The Company was quite willing to pay the Townshend tax of threepence a pound when its tea was landed in America.

In the colonies this cheap tea was greeted as a bribe offered to the people for their consent to a British tax. The merchants were everywhere alarmed. If the East India Company might receive a monopoly for the sale of one article, it might receive other privileges, and the local merchants would then be deprived of most of the colonial trade. In New York and Philadelphia, the Company's ships were not allowed to land, while at the Boston Tea Party a group of citizens, disguised as Indians, tossed £15,000 worth of the offensive tea into the harbor. This brought about the greatest pre-revolutionary crisis, for it was the first act of resistance which had ended in the destruction of a large amount of private property. Since the East India Company was carrying out a British law, Lord North and George III felt that if the colonial opposition went unchallenged, England's authority in America was a thing of the past.

The Five "Intolerable Acts"

Parliament replied to the Boston Tea Party with the five "punitive," "coercive," or "intolerable" acts of 1774. One of these closed the port of Boston until the East India Company was paid for the lost tea. Since commerce was the life-blood of Boston, this act inflicted hardships on all the townspeople, the innocent and the guilty alike. A second act modified the Massachusetts charter of 1691, taking away many of the most highly prized rights of self-government which that province had long enjoyed. The third measure provided that British officials accused of committing crimes in a colony might be taken to England for trial, and the fourth allowed the governor of Massachusetts to quarter soldiers at Boston in taverns and unoccupied buildings. The last act—not intended to punish the colonies—extended the boundaries of the province of Quebec to the Ohio River and gave the Roman Catholics there both religious liberty and the double protection of French and English law.

Had the colonists accepted these acts they would have yielded nearly all their claims to the right of governing themselves. Neither they nor England could now back down without a complete surrender on the part of one or the other.

Why did the final break occur? Ever since the beginnings of settlement, England and America had been growing apart. In 1774, England was still an aristocracy, ruled by men born and bred to a high station in life. Their society was largely one of culture and refinement. The common people, deprived of abundant opportunity at home, accepted a position of dependence. Hard work, deference to superiors, a future without promise, and submission to rulers they did not select—such was their lot in life.

Old England and the "New Englands"

But in America things had taken a different turn. The tone of society was essentially democratic. There were no lords or hereditary offices. Manners were yet crude and society wore a garb of rustic simplicity. The wilderness had attracted men of independent spirit, and the stern conditions of the frontier had bred self-reliance and self-respect. The Americans did not like to look up to superiors, nor were their leaders set apart by privileges of birth and inherited wealth. The opportunities of the New World made men enterprising, energetic, and aggressive. Restraints were few, custom counted for little, and rank for less. Between these two societies there could not be much in common. Convention, decorum, and formality guided the aristocracy of England. Her leaders looked down upon the crude manners of the Americans—their uncouth dress and speech, their boisterous ways, their lack of formal education, and their aspirations for independence and self-rule. Most ancestors of the Americans had belonged to that humble class which was still without political rights or influence in England. What magic of the American woods could transform these lowly folk into peers of the chosen few who lived on the fat of England's fertile soil?

Breaking of Charter Contracts

Equally wide was the gulf that separated the colonists and England in their political thinking. By 1750 British statesmen believed that Parliament had complete authority over the colonies. It could tax them, make laws for them, and even abolish their elected assemblies. All this the patriot leaders in America denied. Parliament was not a free agent, they said; it was bound to respect certain natural rights of man; any of its acts which tried to take these away from British subjects was automatically void. The king, not Parliament, was the link that really bound the colonies to England. They had been planted under his auspices, and the colonial governments rested on charters that he alone had issued. These charters were regarded as contracts between the king and the first settlers, giving them and their descendants the rights of life, liberty, and property. Should England try to take away these rights, the original contract would be broken and the Americans released from their duty of allegiance to the king.

Taxation Without Representation

Foremost among these rights was the one expressed by the saying—"a subject's property cannot be taken from him without his consent." The colonists denied that they were represented in Parliament; therefore they did not give their assent to taxes it imposed. The English leaders, on the other hand, held that all members of Parliament looked after the best interests of the whole empire, and that the colonists were as fully represented as the great mass of English people, who did not have the right to vote at home. Since they believed themselves unrepresented in Parliament, the Americans agreed that only a locally-elected assembly could tax them. In fact, the revolutionary leaders eventually placed the assemblies on a par with Parliament. It should have no more power over them than they had over it. This view meant that the colonies were virtually independent states, held to England by ties of sentiment, but not actually subordinate to her. By 1750 the king could do scarcely anything without the consent of Parliament. Thus the American leaders, by asserting that the colonies were subject solely to the king, recognized only a feeble authority too weak to control them in an effective way.

Misgovernment and Exploitation

The defects of British rule also contributed to the final break. For a long time England had let the colonies drift along with little restraint. There was no central colonial office which was supposed to supervise them; executive authority in England was divided among several ministers and commissions that did not act quickly or in unison. The Board of Trade, which knew more about the colonies than any other body, did not have the power either to decide things or to enforce decrees. English politics were honeycombed with corruption, and agents sent to America were often bribe-taking politicians too incompetent for good positions at home. Distance also counted against England. "Seas roll, months pass between the order and the execution," wrote Edmund Burke. Just before the Revolution, England was governed by rapidly changing party factions that did not hold to a consistent course. Ascending the throne in 1760, George III endeavored to check the growing power of Parliament and to become himself the ruling force in English affairs. His arbitrary acts raised up powerful opponents in England, who regarded the colonists as fellow sufferers in a far-flung struggle between liberty and tyranny. Divided counsels at home, corruption and inefficiency in government, authority divided at the top, sudden changes of policy, measures boldly announced but feebly enforced—all these brought England's claims over the colonies into disrepute. When the Americans had resisted, they had usually gained their point. The liberty they had long enjoyed only whetted their appetite for more.

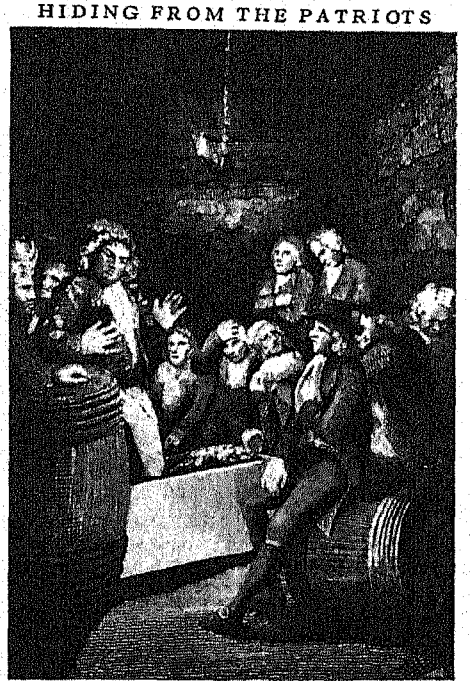
The Colonies as a Source of English Profits

England always treated the colonies as sources of profit to herself, regarding them as dependencies and endeavoring to utilize their resources for her own gain. In the New England woods she tried to prevent the local lumbermen from sawing planks out of trees capable of furnishing masts for the Royal Navy. After 1763 she proposed to control the granting of land in

the West with an eye to her own advantage. Since land was the principal source of wealth among the colonists, they could not prosper to the utmost until its benefits were freely accessible to all the people.

England also controlled the commerce of the empire in order to increase her own wealth. In accordance with England's "mercantile theory," her policies directed that the colonies should produce what she did not and exchange it in her own ports for British goods. As far as possible, the profits of American trade should go to British merchants, and the ready money of the colonies should come to Britain in payment of colonial debts. The assemblies should not do anything to restrict the sale of British merchandise in America, nor should the colonists produce the kind of wares which Britain could supply. These various principles were given force by a series of Acts of Trade that greatly limited the economic opportunities of the colonies and left them little more than farming.

HIDING FROM THE PATRIOTS



This quaint old engraving shows a gathering of Tories in a dim-lit cellar, amid casks and vegetable bins. They had to meet in secret, for if the state government found they had remained loyal to England, they might be banished from their homes and their property seized. Many fled to Canada.

Meanwhile the colonists became increasingly dissatisfied with this condition. Their agricultural produce sold abroad did not bring enough revenue to buy all the manufactured goods they needed. After they became indebted to British merchants, they often felt that they were exploited by their creditors. Denied the right to develop local manufactures, they produced an ever-growing surplus of a few agricultural staples which, flooding the available markets, lowered the final sale price abroad. The remedy for this condition was to cut down the agricultural surplus by developing local manufactures and by engaging in free commerce with all the world. A vast share of America's wealth went to British manufacturers, shipowners, and merchants. Should Americans perform the services formerly supplied by Britain, their wealth would increase, their debts would diminish, and economically they would stand on their own feet.

While the colonies were sparsely peopled and undeveloped, the settlers realized that the benefits they derived from England outnumbered the losses inflicted by British restrictions. Now, however, in 1775, the American people were approaching the stature of manhood. Their population exceeded two and a half million, and their growing wealth was able to support new enterprises of which England disapproved. The time had come when it seemed that the Americans could do for themselves what England had done before, and that the increase of wealth which freedom promised would overbalance the cost of defending their frontiers, of maintaining a navy, and of securing commercial privileges for their products abroad in free trade with other countries besides England.

The Organization for Revolution

That they might act together in resisting the measures of Britain, the colonists built up an effective revolutionary organization. This may be likened to a pyramid. The bottom stones consisted of committees of correspondence first erected in the New England towns through the influence of Samuel Adams and at the suggestion of Boston. Elsewhere such committees were generally established in the counties. They enabled the people of each locality to act together, and to communicate with fellow colonists in remote places. When the break with England came, these and similar committees took charge of the work of local government (*see* Adams, Samuel; Lee, Richard Henry).

The next layer of the pyramid consisted of provincial congresses. These in some cases were the former assemblies meeting in defiance of the English governors. Others were unauthorized bodies composed of delegates selected by the committees in the towns or counties. When England's authority was rejected, these congresses were ready to make laws, and to provide soldiers and money for carrying on the war.

At the apex of the pyramid stood the Continental Congress. The delegates who attended its first meeting at Philadelphia in 1774 were nearly all members of local committees of correspondence, and many of them had been selected by the provincial congresses. They adopted a declaration denouncing parliamentary taxation and the "five intolerable acts," and signed a "Continental Association" intended to destroy all trade with England if she did not yield. More important, the Congress prepared to enforce this agreement on all communities by means of the local committees. The only authority which the Congress had came from the people themselves, and its acts were not regarded by England as law. When it attempted to force everybody to follow a certain course of action, it assumed the power of a *de facto* government. The colonial leaders had now divided into two camps—the Patriots, willing to accept the Congress as their guide,

and the Loyalists, who were willing to abide by Parliament's decree and counseled submission.

Conciliation or Force

Meanwhile the air was full of plans for conciliation. Lord North suggested that England should not tax the colonies if they would provide a permanent revenue for the support of British officials stationed there. Let the colonists return to their old ways, said Edmund Burke; let them vote their own taxes and govern themselves. William Pitt (now Lord Chatham) would repeal the "intolerable acts" and promise that taxes should not be levied by Parliament except with the consent of the American assemblies. At the first Continental Congress, Joseph Galloway of Pennsylvania proposed to erect an American legislature, subordinate to Parliament, which would have the right to veto all British laws relating to the general interests of the colonies. Some leaders would admit American representatives into Parliament, and a few Englishmen were ready to give the colonies their independence. But all these plans failed. Neither side would make any real concessions to the other until the issue had been decided by force.

Fights in and about Boston

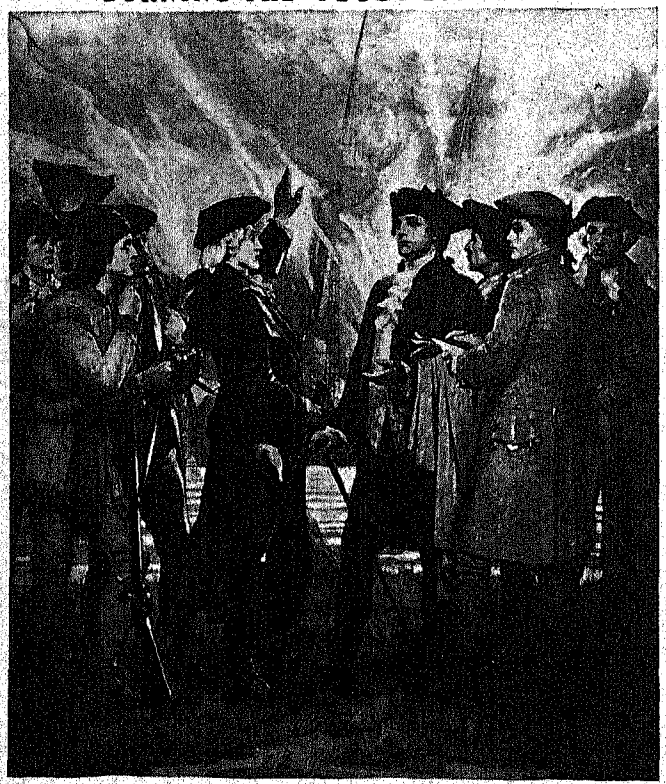
British troops were sent to Boston, the center of resistance, as early as 1768. On March 5, 1770, the friction between them and the townspeople flamed into violence at the Boston Massacre, when the soldiers fired into a mob killing five men and wounding several others.

The enforcement of the "intolerable acts" by a military governor and troops set the people seething with the spirit of revolt. On the memorable night of April 18, 1775, Paul Revere and William Dawes spread the hurried news that British "redcoats" were coming to Lexington to seize Samuel Adams and John Hancock, and to Concord to capture the stores of war which the patriots had gathered there. Embattled farmers assembled at Lexington on the road from Boston, and there occurred the first fighting which proclaimed the coming of war. (*See* Hancock, John; Lexington and Concord, Battle of; Revere, Paul.)

War: Handicaps of the Americans

Five and a half years elapsed before the land again enjoyed peace. Why did the war last so long? At the start the Americans did not have a unified army. Their first forces consisted of colonial militia headed by local leaders not accustomed to taking orders from a superior commander. Nor did the ordinary soldiers like to obey their officers. There was no central system of housing, paying, or feeding the troops, and supplies of gunpowder and clothing were inadequate.

BURNING THE 'PEGGY STEWART'



Annapolis' answer to the tea tax was this burning ship. Anthony Stewart, town merchant and shipowner, paid the duty on its tea cargo so the indentured servants on board might land. The enraged patriots forced him to fire the ship. In this mural by C. Y. Turner, in the Baltimore Court House, the patriot leader and the shipowner confer while the flaming vessel lights the scene.

When a common army was formed, short-term enlistments required that it be frequently built anew, and it probably never contained more than one-tenth of the Americans who could have given military service. All the time the states were rent by party strife. Perhaps a third of the people remained faithful to the king. They served at times in his army, fitted out privateers to prey on American commerce, and plundered the property of patriot farmers. In retaliation the states confiscated the wealth of these Loyalists or Tories, drove thousands of them from their homes, and declared any person who joined the British army a traitor deserving death. Unscrupulous profiteers sold supplies to the king's forces when the American army was in dire need. This lack of unity at home and the need of conquering two foes at once weakened the efforts of the patriots and postponed the final hour of victory.

Mistakes and Jealousies

The Revolution was a new and strange undertaking, requiring 13 states jealous of their local rights to act in unison. At times the South felt neglected by Congress, and often the states held back in giving aid, each fearing that it would carry more than its share of the burden. In those days of stress, when things went wrong, all the people could not agree on a single remedy or follow leaders without criticizing them. Many mistakes had to be made before the right

methods and the best leaders were discovered. There were personal jealousies, also. Benedict Arnold, placed in charge of West Point, which had been strongly fortified by Kosciusko, plotted to deliver this strategic point to the British, because he thought he did not get enough recognition for his services to the patriot cause. (*See* Andre, John; Arnold, Benedict; Kosciusko, Thaddeus; Military Academy, United States.)

The incompetence of Gen. Charles Lee accounted for two costly American disasters. When Washington was enduring every conceivable hardship at Valley Forge in 1777–78, an intrigue in Congress known as the "Conway Cabal" aimed to put General Gates in his place as commander-in-chief.

"THE SHOT HEARD ROUND THE WORLD"

This little band of Minutemen at Lexington, Mass., April 19, 1775, shed the first blood in the long war for American freedom. But they were unable to hold their ground against the large force of redcoats glimpsed through the smoke of musket fire.

All in all, it was a stupendous task that faced the patriots. They had to improvise an army and a new government at the same time, to meet unusual situations arising every day, to find trusted leaders, and to get 13 proud states to work for the common cause. And all this had to be done with little preparation, without the aid of settled rules, and with the ever-present menace of defeat and reprisals for rebellion and treason casting a black shadow over the land.

The Problem of Finances

Moreover, the Continental Congress never had the right to levy taxes. When it asked the states for money, those not immediately in danger frequently failed to respond. Little aid at first could be obtained abroad; many of the wealthiest men in America remained Loyalists; and the patriots could not seize people's property for war purposes without raising a storm of opposition. All these conditions forced Congress to issue an immense volume of paper money or bills of credit. These bills were promises to pay the holders of them a certain sum of money in the future. Congress used them to buy supplies and to compensate the soldiers. Each state was supposed to provide money to enable Congress to give silver to the owners of the bills. But this was not done, and no cash fund was created to keep up their value. As they passed from hand to hand, they gradually became worth less and less in silver, so that the loss was spread over a long time and borne by all the people. If a person received a paper dollar when it would buy 90 cents in silver or goods, and if its real value had fallen to 85 cents when he used it again, he lost 5 cents on the deal. When this Continental currency had become worthless, Congress called upon the states for quotas of food for the army, but this proved to be a very wasteful method. A large sum of money was borrowed from private citizens who received interest-bearing securities of the United States in return.

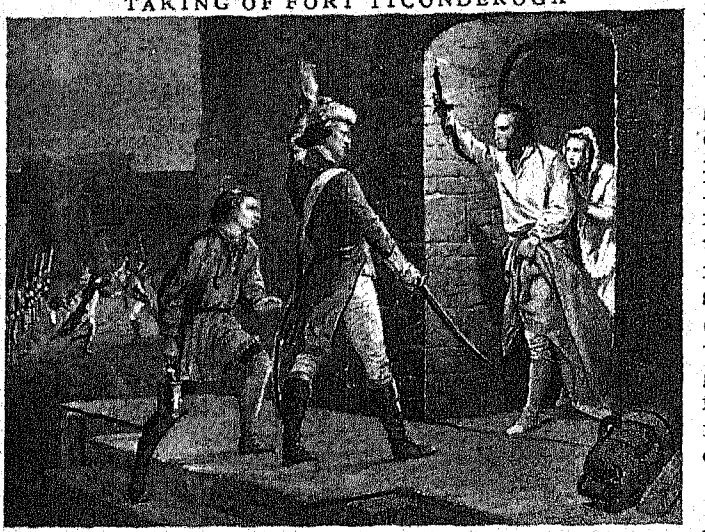
During the early years of the war, when Congress did not have a navy, England easily controlled the sea. Her powerful fleet enabled her to blockade much of the coast, and to strike wherever she chose, capturing American ports almost at will. Her wealth, industrial resources, and military experience provided her with well-equipped troops—some of them Hessians, hired in Germany—under the command of seasoned officers. So great were the odds against the colonies and so powerful was England at the start that other European states hesitated to help Congress lest they raise against themselves a dreaded foe.

Advantages of the Americans

But in the long run stronger influences favored the Americans. They knew the lay of the land where the fighting had to be done better than the British did, and were used to the rough living conditions which war brought in its train. The typical settler felt quite at home with a rifle in hand. The damage done by the redcoats incensed the people and aroused their fighting spirit. Britain's soldiers had no real interest in the war, while the Americans were defending their firesides and their settled way of life. Acting on the defensive, they could afford to wait till England moved and then assemble their forces where danger threatened most. If the colonists were really to be subdued, the whole countryside had to be conquered. Their communities were largely self-sufficing units that could not be crushed by the capture of a single city or an important road. This meant that England had to wage a series of campaigns on land. The

difficulties of moving an army over miry roads were terrific. Nor did she have enough troops to occupy all regions at once: when she concentrated on the middle states she had to neglect New England and the South. She could not well keep soldiers in every village, and when they were withdrawn, the people were ready once more to take up arms. At a time when an army could march only a few miles a day, it was a stupendous task to subdue isolated settlements stretching from Maine to Georgia and reaching in places 300 miles beyond the coast. All the greater was the difficulty when the invaders had to bring troops and supplies across the ocean.

TAKING OF FORT TICONDEROGA



Here Ethan Allen on May 10, 1775, demands the fort's surrender "in the name of the Great Jehovah and the Continental Congress," from the British commander, routed from bed by Allen's surprise attack.

Foreign Aid

However, without help from Europe the Americans might not have won the day. The hope of such aid was one important reason why Congress adopted the Declaration of Independence in 1776, for European states would not interfere so long as the colonies still recognized the English king (*see* Declaration of Independence). Agents now sent to France were able secretly to procure clothing and muskets. Individual Frenchmen—headed by the Marquis de Lafayette—served as volunteers in the American army (*see* Lafayette, Marquis de). The great victory at Saratoga in 1777, made possible by gunpowder received from France, seemed to assure the final triumph of the American cause (*see* Saratoga Springs, N. Y.).

France now recognized the independence of the United States, and formed an open alliance with Congress. Her foreign minister, the clever but unscrupulous Vergennes, persuaded King Louis XVI that England was about to make peace with the colonies and join with them to seize the French West Indies. The new alliance—the only one ever entered into by the United States—allowed Congress to borrow an immense sum of money from France. French troops now took part in the war, and the French navy later bottled up Cornwallis' forces at Yorktown and hastened his surrender. France also induced Spain to make war on England in 1779.

Aid likewise came from other sources. Baron von Steuben, a German, trained in the army of Frederick the Great, taught American officers the art of war, and helped to make the troops better fighters (*see* Steuben, Frederic William Augustus). An outlet for American produce was found at a Dutch island in the West Indies; there likewise military stores were obtained. England's power on the sea forced Russia, Prussia, Denmark, Sweden, Holland, and the German Empire to enter into a league of armed neutrality in 1780. These states asserted that goods carried in a neutral ship should not be seized in time of war. The Dutch secured so much trade that England declared war on them in 1780 in order to take away their rights as neutrals. Congress was then able to borrow additional funds from Holland, and England was now confronted by the combined fleets of three continental foes.

Naval Activities

The United States was not wholly powerless on the sea. Trading vessels were quickly prepared for fighting service, while Congress began the construction of a navy. Special letters of authority were given to merchantmen allowing them, as privateers, to seize British vessels. These took so many British ships that ocean insurance rates increased tremendously, and English merchants began to see the advantage of peace. American warships under Esek Hopkins, John Paul Jones, and John Barry proved themselves equal to English frigates, and in 1779 even the remote British coast felt the sting of direct contact with the American war (*see* Jones, John Paul).

The American Leaders

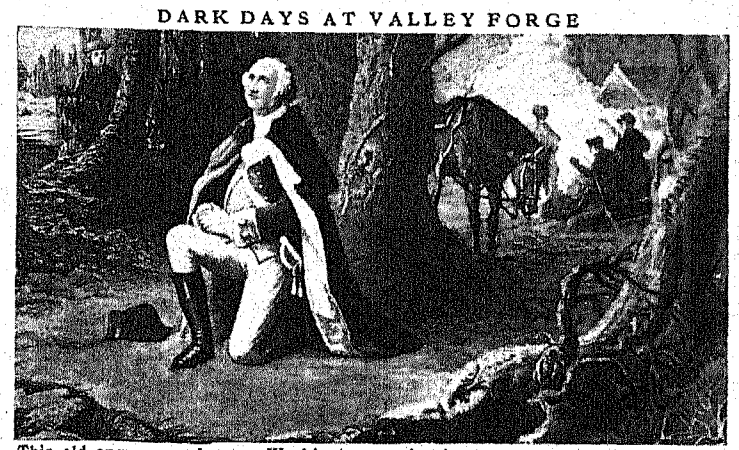
The needs of the time brought forward an unusual group of leaders. George Washington, as commander-in-chief of the army, kept the American cause on its feet, inspiring hope by his courage, patience, and firmness during the darkest hours of defeat. To Benjamin Franklin belongs much of the credit for securing aid from France (*see* Franklin, Benjamin). As an agent of Congress, he became the idol of Paris, using every art of diplomacy to win the good will of all classes in French society. Robert Morris took charge of raising money for the war (*see* Morris, Robert). Others, like John Adams and Thomas Jefferson, struggled against discord in Congress and rallied the people against despair (*see* Adams, John; Jefferson, Thomas). The Americans as a whole were a tough, sturdy race, able to endure privation and hardship. Rarely has a country with so small a population as the

13 states produced so many first-class leaders in a single generation as did the American Colonies.

The Whigs in England

One other thing favored the Americans: England was not united at home. Setting out to be a real ruler, George III became the leader of the Tory party, and attempted to make the king superior to Parliament (*see* George III). His opponents, the Whigs, believed that he was ready to destroy the liberties of the English people. His arbitrary course called forth a reform movement: more people should vote, and the king should not stifle criticism of his acts as he had done. One group of Whigs, headed by Lord Rockingham, believing that the colonies could not be subdued, wanted to give them their freedom. Others favored compromise. Even Lord North disliked the war, but when he tried to resign, George III threatened to leave the throne. Lord North stayed, acting against his better judgment in order to please the headstrong king. All the while the Tories stiffened the resistance of the Americans by treating them as hateful rebels. Moreover, opinion was changing; Adam Smith, in his 'Wealth of Nations' (1776) argued that the trade of free states in America would be as profitable to England as the trade of colonies. Alarmed by defeats in 1781 and uprisings in Ireland and India, Parliament in 1782 demanded the king end the war.

DARK DAYS AT VALLEY FORGE



This old engraving, showing Washington praying in the snow at the Valley Forge encampment, aptly symbolizes his anxiety for his ragged army during that bitter winter when American fortunes were at a low ebb.

The Story of the War on Land

When the British fell back from Concord to Boston in April 1775, the farmer militiamen of New England immediately besieged the city. The Second Continental Congress, meeting at Philadelphia in May 1775, now took charge of the war and appointed Washington commander-in-chief. Before he arrived at Boston, the New Englanders had made a valiant attempt to hold Bunker Hill, preparatory to bombarding the British troops and fleet in the city. Forced to retire by lack of powder, the Americans had given a demonstration of bravery and skill that left England little cause for rejoicing (*see* Bunker Hill, Battle of). The New England militiamen, soon reinforced by Continental troops, held the city beleaguered until the British commander, Lord Howe, elected to move his army to Nova Scotia in March of 1776. New England thereafter escaped the ravages of war on land.

TRAINING THE PATRIOT ARMY

Here colonial officers watch Baron von Steuben drilling Continental soldiers in maintaining continuous fire in battle, one rank loading while the other kneels to fire. His rigorous training did much to turn Washington's unskilled force into an efficient army.

At the very start the Americans, taking the offensive, sent expeditions to conquer Quebec. New England forces, under Seth Warner and Ethan Allen, captured Crown Point and Ticonderoga on Lake Champlain, valuable for their stores of war (*see* Allen, Ethan). Montreal fell in November 1775, but the siege of Quebec under Gen. Richard Montgomery and Benedict Arnold failed. Montreal and Crown Point were recovered by the British early in 1776, but Ticonderoga, remaining in American hands, blocked the best line of advance for the English from Canada to the south.

New York and the Hudson

The scene now shifted to New York, where Washington, who feared an attack on the city, had taken his army in April 1776. Since New England was regarded by the British ministers as the center of resistance, they planned to crush the region by surrounding it and cutting off its supplies from the outside, thereby starving the people into submission. This was to be done by occupying New York. An army would then advance south from Canada to some point on the Hudson River, where it would meet another army moving north from New York. New England would then be

isolated; the 13 states would be rent in twain; and the colonies in the south could be conquered at will.

Washington Crosses the Delaware

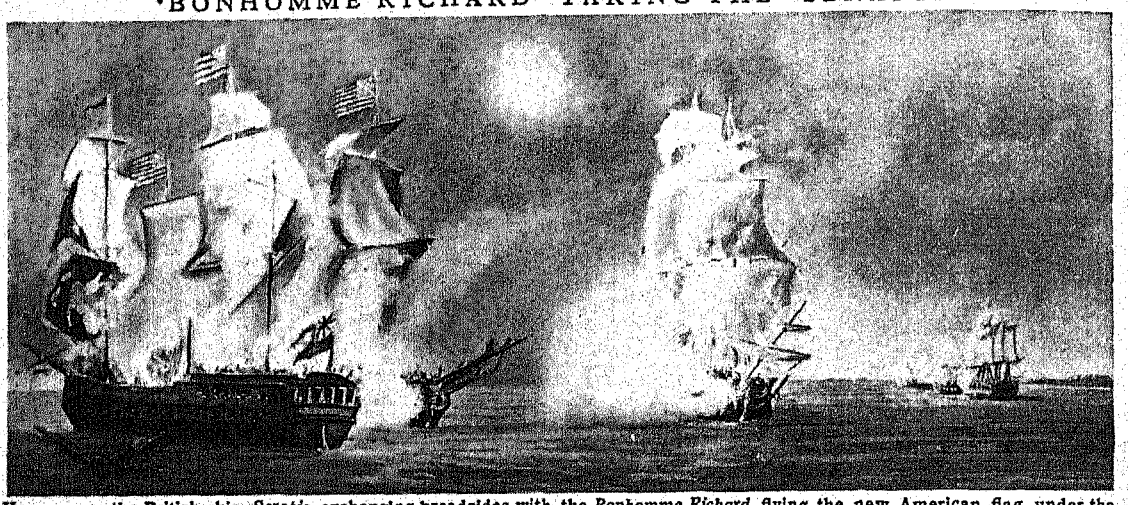
Confronted by a superior force, Washington had to leave New York, where his troops had fought bravely in the battle of Long Island and at Harlem Heights, and to retreat up the Hudson (*see* Hale, Nathan; Long Island, N. Y.). At the battle of White Plains, October 9, the British gained a costly victory. Pursued by Gen. William Howe, Washington abandoned the American forts on both sides of the river above the city and fell back into New Jersey. He saved his army by collecting all boats along the New Jersey side of the Delaware River and then by crossing it to the Pennsylvania shore. The American cause seemed lost. Congress beat a hasty retreat from Philadelphia to Baltimore. But Washington now struck one of the most critical blows of the war. Recrossing the Delaware on Christmas night, 1776, he fell upon the Hessian mercenaries at Trenton and took a thousand prisoners. A few days later he won a second victory at Princeton. The British gave up New Jersey; the middle states were safe for the time; and Washington, unmolested, went into winter quarters at Morristown—his army saved from what had seemed a certain annihilation and the American cause from collapse.

Germantown, Oriskany, and Saratoga

In 1777, Britain planned a three-fold attack. General Howe was to advance north from New York, General Burgoyne south from Quebec, and St. Leger east from Lake Ontario. The three forces, meeting at Albany, would cut New England adrift from the other states. Because Howe failed to receive part of his instructions, he first undertook the capture of Philadelphia. In opposing Howe's advance, Washington lost two engagements at Brandywine Creek and at Germantown. With his ragged army, he starved and froze at Valley Forge, through the next winter. But he had really succeeded, for he kept Howe busy before Philadelphia until it was too late for him to coöperate with Burgoyne and St. Leger.

This meant that Burgoyne had to act from the north alone. He managed to get to Saratoga, a few miles north of Albany where he found himself isolated.

'BONHOMME RICHARD' TAKING THE 'SERAPIS'



Here we see the British ship, *Serapis*, exchanging broadsides with the *Bonhomme Richard*, flying the new American flag, under the Yankee commander, John Paul Jones, in the famous sea battle by moonlight off the northeast coast of England, Sept. 23, 1779. Although his ship was sinking, *Jones* fought desperately until the *Serapis* lowered the Union Jack.

He was severed from Canada by an almost impenetrable wilderness. His army, without supplies, was cut nearly in half by the hard march through the woods, and outnumbered three to one by American troops and New England militiamen who had poured in upon the invaders. A British force sent to Bennington, Vt., to capture stores of war had been repulsed on August 16 by the local militia under John Stark. Meanwhile, St. Leger, defeated by the Americans at Oriskany under General Herkimer, could not reach Albany to rescue Burgoyne's encircled army. At Saratoga, on Oct. 17, 1777, over 5,000 British troops laid down their arms. New England was saved; France soon entered the war; and the dawn of success lighted the American sky.

The British Leave Philadelphia

Threatened by French troops on the way to Delaware Bay, the British under Clinton, who had replaced Howe, gave up Philadelphia and set out for New York. The Americans met them at Monmouth, N. J., on June 28, 1778, where a certain victory was thrown away by the treachery or cowardice of Gen. Charles Lee, and the British escaped to New York. Washington now occupied White Plains up the Hudson River above New York.

Raids and counter-raids occupied the Continentals, the British, and their Indian allies in the middle states during the next two years. On the arrival of the French fleet in 1778, Washington sent a land force under Gen. John Sullivan to coöperate with the ships

WHEN THE BRITISH SURRENDERED AT YORKTOWN

The victorious American troops (on the right) and their French allies (on the left) are drawn up to receive the surrender of the British army at Yorktown, Va., in this picture by John Trumbull. Lord Cornwallis was too ill to be present, so Gen. Charles O'Hara hands his leader's sword to Gen. Benjamin Lincoln, appointed by Washington (at right rear) to accept the submission.

in an attack on the British at Newport, which failed. A famous victory of 1779 was the seizure of Stony Point, from the British, in a bayonet attack under "Mad Anthony" Wayne (*see* Wayne, Anthony).

War in the South

Late in 1778 the British turned to the South. They had been persuaded that the people there were less "rebellious" than in the North, and that a great Tory uprising would greet a British force. The main American army was hundreds of miles away in New York. Although the British captured the coast towns of Georgia and South Carolina, and although they defeated an American army at Camden, S. C., August 1780, their new campaign did not succeed. Two of America's foreign heroes, Baron De Kalb and Count Pulaski, were killed while they were defending the South in this campaign (*see* De Kalb, Baron Johann; Pulaski, Casimir).

The southern patriots were aroused by the victory of a thousand frontiersmen under Isaac Shelby and John Sevier at King's Mountain, on the border between the Carolinas, Oct. 7, 1780, over an equal force of Cornwallis' regulars. Thereafter intrepid leaders like Andrew Pickens, Francis Marion, "the swamp-fox," and Thomas Sumter, sweeping down unexpectedly upon the British outposts, proved that the hilly back country could not be held against the patriots (*see* Marion, Francis; Sevier, John). Washington now put Gen. Nathanael Greene in charge of the regular American army in the South. Not strong enough for a direct attack, Greene worried Cornwallis' troops and was in turn pursued across North Carolina. In the meantime, militiamen under the great ranger, Gen. Daniel Morgan, supported by Col. William Washington's cavalry, slaughtered a British force under brilliant Col. Banastre Tarleton at Cowpens, S. C., Jan. 17, 1781. After inflicting some damage on the British at Guilford Court House, N. C., on March 15, Greene returned to South Carolina to fight the battles of Hobkirk's Hill and Eutaw Springs, and drive part of the British forces into Charleston. Cornwallis led the remainder of his depleted army into Virginia, where he found a small American force under Lafayette. Unable to capture the French leader, Cornwallis retired to Yorktown and prepared to embark the remnant of his army for New York.

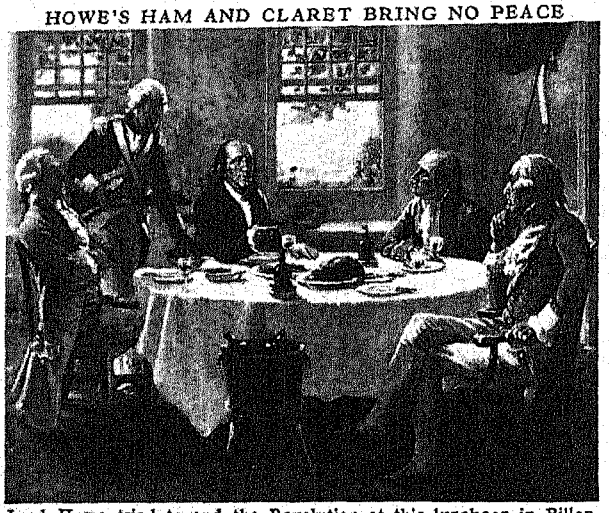
The Surrender at Yorktown

When this news came to Washington, now on the Hudson, he prepared the decisive stroke. He arranged to unite his main army with a French force under Rochambeau, then in Rhode Island, and to march overland to join Lafayette at Yorktown (*see* Rochambeau, Count de). A French fleet under De Grasse was to come from the West Indies to Chesapeake

Bay, thereby shutting Cornwallis' outlet to the sea. Every detail of the plan was carried out, and on Oct. 19, 1781, Washington received the surrender of Cornwallis' entire army. This was the end.

Twice during the war England had tried to win back the Americans by offers of peace. Lord North and Parliament went so far in 1778 as to promise to yield on all points in dispute. But it was then too late. After Congress had declared for freedom, its spokesmen took the stand that the United States were and must remain a separate nation. Following the victory at Yorktown, Lord North resigned and a new ministry favorable to American independence came into power in England. Congress named five commissioners, John Adams, John Jay, Franklin, Jefferson, and Henry Laurens, to make a treaty of peace. Jefferson did not go, and Laurens reached London only two days before the preliminary treaties were signed. They were instructed not to make peace without the knowledge and consent of France, for joint action in closing the war had been required by the French-American alliance of 1778.

HOWE'S HAM AND CLARET BRING NO PEACE



Lord Howe tried to end the Revolution at this luncheon in Billop House, Staten Island, Sept. 11, 1776, but Benjamin Franklin, John Adams, and Edward Rutledge would accept no terms but American independence, so the war dragged on.

Disposition of the Western Lands

One very important question had to be answered: who should obtain the land between the mountains and the Mississippi? The United States wanted it, for already American settlements had been established there. Those in Kentucky constituted a county of Virginia; those in Tennessee, a county of North Carolina. Acting under Virginia's authority, George Rogers Clark had wrested the western posts of Kaskaskia and Vincennes from the British, so that the close of the war found the Americans in possession of the Ohio Valley (*see* Clark, George Rogers). But Spain, already holding the west bank of the Mississippi, wanted the whole Mississippi Valley. France, not eager to see the United States become too powerful, was willing.

The Peace Treaty

Fearing (not without reason) that Spain and France were ready to betray the United States, Adams and Jay outvoted Franklin, decided to ignore the French alliance, and negotiated a preliminary peace treaty with England, which was signed at Paris, Nov. 30, 1782. The Americans secured their independence and the land west to the Mississippi. They were also allowed to fish in the waters off Newfoundland, but not to dry or cure their catches on the island. Under the treaty Congress agreed to recommend to the states that they compensate the Loyalists for property taken from them during the war, and no laws were to be passed to prevent the payment of debts which Americans owed to British merchants. The boundary on the north included the line of the Great Lakes, and the citizens of both the United States and Britain were to have the right to use the Mississippi River. France acted with good nature in accepting this treaty, which was made final by the Treaty of Paris, Sept. 3, 1783. On the same day a general peace was concluded between England and her European foes.

The American Revolution was a great social movement tending toward democracy and equality. Thousands of Loyalists had fled from the 13 states to Canada. Remembering how harshly they had been treated by the patriots, they strengthened the earlier determination of the Canadians to hold aloof from the United States. Vast estates of land had passed from the king, from the colonial proprietors (in Pennsylvania and Maryland), and from Loyalists into the hands of the new state governments. These estates were now broken up into small tracts and distributed among the people at a low cost, or given to patriot soldiers as a reward for military service. For a century thereafter, the United States was to be a nation of small farm owners, each enjoying the fruits of his labor and recognizing no overlord save the government. The barriers that had checked the westward movement were broken down, and a flood of settlers sought the lands beyond the mountains. State governments had been erected; the first experiment in national union was in progress (*see* Articles of Confederation; United States, Constitution).

RHETORIC (*rĕt'ô-rĭk*). Grammar teaches the proper uses of words and how to combine them correctly into sentences. Rhetoric goes farther and teaches us to speak and write not only correctly but *effectively*—so as to produce a desired impression upon a reader or hearer. Grammar says, "This is right, that is wrong." Rhetoric says, of two or more ways of putting an idea, "*This* is the best way to convey the thought." Rhetoric seeks not only correctness, though this is of course always the first essential, but also *clearness, unity, force,* and *beauty* in expression.

Rhetoric was first taught by the ancient Greeks and meant originally the art of the orator, of speaking

so as to persuade or move others. The methods used by the rhetoricians were not always the highest, for some of them did not scruple to "make the worse appear the better cause," aiming at success rather than truth. The abuse of the art of rhetoric accounts for the use of the term, as we sometimes hear it, in the sense of affected and artificial language. However, Aristotle (*see* Aristotle), who in the 4th century B.C. wrote a treatise on rhetoric which has never been surpassed in grasp of the scientific principles of writing, taught that this was not true rhetoric; and all who have thought deeply about the subject agree that no tricks of expression can take the place of sound reasoning, and that power and true beauty go hand in hand with sincerity.

In later times, especially since the invention of printing, writing has come to be more important than oratory; so rhetoric has become concerned more with the art of writing than with that of speaking. But it is well to remember its connections with oratory. If in writing we put ourselves in the place of the orator, who must so express himself that his message will strike home to his audience, we shall write more clearly, and, what is hardly less important, more suitably. We shall be less likely to make such bad mistakes as using flowery poetic language in a business letter, or colloquial language in an essay on a lofty subject. We shall be able to write more interesting stories if we have in mind someone listening to these stories; we can write better descriptions if we are trying to make someone else see what we see.

Important as is the study of the rules and principles of rhetoric, no one claims that this study alone will make a writer. As a student once wrote at the close of a course in rhetoric—

> You may study facts and methods
> Till your form is worn and thin,
> But the way to fame in writing—
> Take your pen and then begin.

"Learning by doing" is a safe motto in this as in everything else, and practice in writing is of the first importance. Consequently rhetoric as it is taught in schools and colleges consists largely of writing "themes," using the principles of rhetoric as a guide and as a means of correcting mistakes and improving one's style. (*See also* Figures of Speech.)

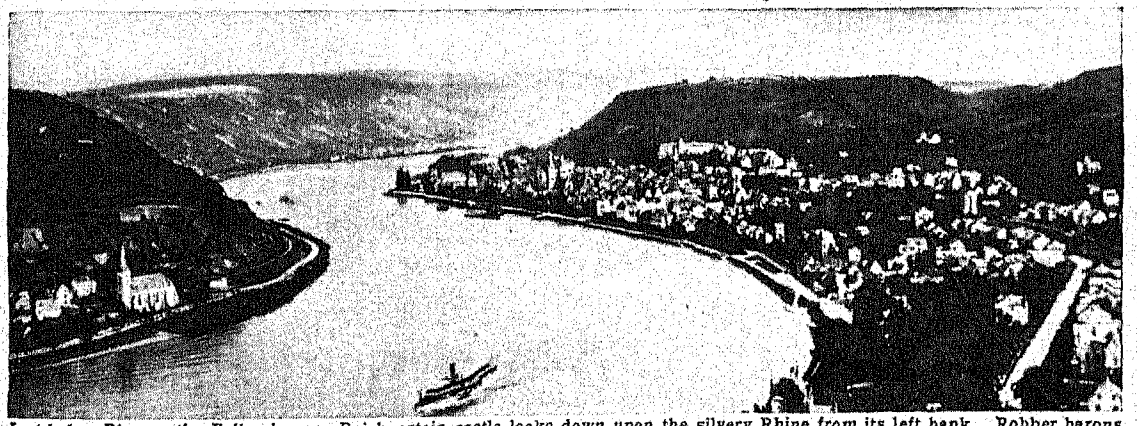
RHINE RIVER. Through the ages, the beautiful Rhine has stirred the desires and the fancies of men. Conquerors from Charlemagne to Napoleon to Foch have fought to possess this shining avenue of commerce. To the German, the Rhine is symbolic of patriotism. His best-loved national song is 'The Watch on the Rhine'.

The Rhine takes its rise among the Alps of Switzerland, and after a northerly course of about 850 miles empties into the North Sea. The area drained by the Rhine and its feeders is estimated at nearly 100,000 square miles. It is divided into the upper, middle, and lower Rhine, the first being the river from its mountain source to Basel, the second its course from Basel to Cologne, and the third its course from Cologne through the Netherlands to the sea, into which it empties by mouths forming an extensive delta.

Canals connect the Rhine with the Rhone, the Danube, and other rivers, opening lines of water communication with France and Belgium on the one side and with the Netherlands and every part of Germany on the other. The Moselle joins the Rhine at Coblenz nearly opposite the confluence of the Lahn. It is the largest tributary, and the Moselle from Coblenz to Trier is fully as beautiful as the Rhine itself.

The falls of the Rhine at Schaffhausen are to Europe what Niagara is to America. The picturesque castles and terraced vineyards of its middle course make a trip on the Rhine one long to be remembered. Among many points of interest are the castles of Rheinstein, Rheinfels, Drachenfels, and Stolzenfels (the latter a modern restoration), the frowning fortress of Ehrenbreitstein—the "German Gibraltar"—old Bingen with its "Mouse Tower," where false legend says the hated Bishop Hatto was devoured by rats, and the great rocks where once the Lorelei,

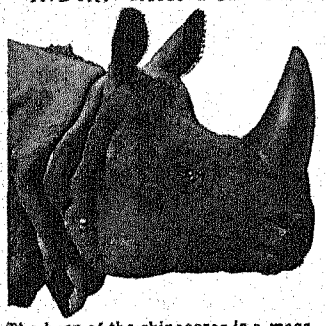
A ROBBER STRONGHOLD ON THE MAJESTIC RHINE



Just below Bingen, the Falkenburg or Reichenstein castle looks down upon the silvery Rhine from its left bank. Robber barons built this stronghold in the 13th century, but Rudolf of Hapsburg soon destroyed it, hanging the entire garrison. The lords of Falkenburg figure prominently in Rhine legend. This castle was restored in the 19th century.

with her golden hair and ravishing beauty, lured mariners to destruction. Important cities in the Rhine territory are Strasbourg, with its famous cathedral and university; Spires and Worms, towns of Reformation memories; Mainz and Cologne, seats of Catholic archbishops whose great cathedrals tower over the modern buildings; busy industrial Mannheim, and Coblenz, occupied by the American troops until 1923, as one of the three "bridgeheads" of the Rhine following the armistice. Unfortunately, the noise and smoke of industry have of late years marred some of the Rhine's beauty.

INDIAN RHINOCEROS



The horn of the rhinoceros is a mass of tough fiber growing from the skin, and is not part of the skeleton.

From the earliest times, the Rhine has been one of Europe's most important waterways. Most of the traffic is composed of fuels, ores, and cereals.

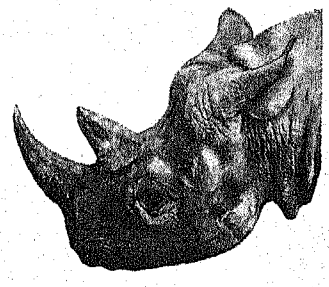
RHINOC'EROS. Tiger's claws and lion's teeth have no terror for the rhinoceros. It wears a skin-armor so thick that even the iron spears of the native hunters can hardly cut through it. And this great lumbering creature, for all its 5,000 or 6,000 pounds, can crash through the jungle at such speed and use its terrible horn in such a way as to keep even the king of beasts at a respectful distance.

The legs are short and thick, its feet broad and heavy with toes incased in hooflike nails. The small tail ends in a tuft, and the large piglike head is surely as ugly as nature ever formed. The dull-sighted eyes are small, the keen ears large and erect. The upper lip, which is long and pointed, reaches out and over the lower, and above it on the extended nose is the great horn that may be from one to two or more feet long. Some species have a second and shorter horn just back of the first.

With its horn the rhinoceros not only defends itself but easily uproots the shrubs and young trees, on the roots, leaves, and fruit of which it feeds. It is with this horn too that the mother pilots her calf about the jungle. The calf runs in front of the mother, and she seems to guide it by holding the tip of her horn against its rump. No matter what the change of pace, the horn always seems to keep the same position.

Among land animals only the elephant exceeds the rhinoceros in size. The square-mouthed, or "white," rhinoceros of Africa, largest of the five living species, may be six feet high and more than thirteen feet long. The one-horned Indian rhinoceros, which is the one we most often see in captivity, is rarely over five feet high. The extinct woolly or hairy rhinoceros which abounded in northern Europe and Siberia in the days of the cave dwellers thousands of years ago was no larger than the square-mouthed species, but its front horn was more than four feet long.

AFRICAN RHINOCEROS



The lumpy head of the square-mouthed rhinoceros of Africa is adorned with two horns.

The habits and appearance of the species differ. The grayish-black skin of the Asian species is arranged in great folds that give it the appearance of plates of heavy armor. The African rhinoceros has a smoother skin with less marked folds. Some live on plains, some in swampy jungles. Generally they sleep during the day and move about in the cool of the evening and at night. Unless molested they are peaceful, but when brought to bay or wounded they are so fierce that a rhinoceros hunt is one of the most exciting of jungle experiences. They are generally hunted with tamed elephants.

THE REAL "UNICORN" IN ALL ITS GLORY

The scientific name of the Indian rhinoceros is *Rhinoceros unicornis*, but, with its clumsy body, its thick, welted skin, and its nightmare head, it is as unlike the graceful Unicorn of fable as anything could be.

But the rhinoceros has one enemy that does not in the least mind its raging. A certain fly creeps between the folds of the leathery skin and there burrows into the sensitive flesh. Now all the great strength of the rhinoceros will not help him. He must wade into the water and wallow in the mud until he rids himself of the pests. The hornbill, a tropical bird, is fond of these particular flies, and a strange partnership is the result. The rhinoceros gives the bird the freedom of its body on which it alights to poke its bill into the skin folds. And in return for a meal of flies, it acts as eyes for the short-sighted monster, for, if an enemy approaches, it flutters before the rhinoceros uttering warning cries.

The full-grown rhinoceros, quietly munching hay in the zoölogical garden, is little like the raging beast of the wilds, but that is because it was captured when a baby. Capturing a young rhinoceros is a long and dangerous task. It may take weeks to locate a female rhinoceros with a calf young enough to be transported to the far distant zoo. When the haunt of the female has been found, a pit is dug in the path leading to the water and concealed by boughs. As the mother comes down the path, the calf just in front crashes into the trap. The mother is terrified. Any visible foe she would charge, but the mystery of this sudden disappearance puts her to flight.

Rhinoceroses are seldom seen in herds; generally they are found singly or in pairs. They are no longer common for they do not increase rapidly and have been much hunted. A calf is born at long intervals and they are not long-lived animals. The oldest by actual known record was an Indian rhinoceros that lived for 40 years in a London zoölogical garden.

LITTLE RHODE ISLAND *and Its* BIG MILLS

RHODE ISLAND. Scores of huge many-windowed cotton and woolen mills, with their thousands of humming spindles and roaring looms—that is the picture of Rhode Island that lingers with visitors.

Extent.—North to south, 48 miles; east to west, 37 miles. Area, 1,214 square miles. Population (1940 census), 713,346.
Natural Features.—Low hilly country; Atlantic Ocean on the south; Narragansett Bay extending 28 miles inland in the southeast. Principal rivers: Providence and its tributaries, the Blackstone and Pawtuxet, emptying into the bay; Pawcatuck, into the Atlantic. Mean annual temperature, 46°; mean annual precipitation, 41".
Products.—Hay, potatoes and other vegetables, fruit; dairy cattle and dairy products, poultry, oysters, clams, lobsters; woolens, silk goods, cotton goods, dyed and finished textiles, jewelry, silverware, machinery, food products.
Cities.—Providence (capital, 253,504), Pawtucket (75,797), Woonsocket (49,303), Cranston (47,085), East Providence (32,165).

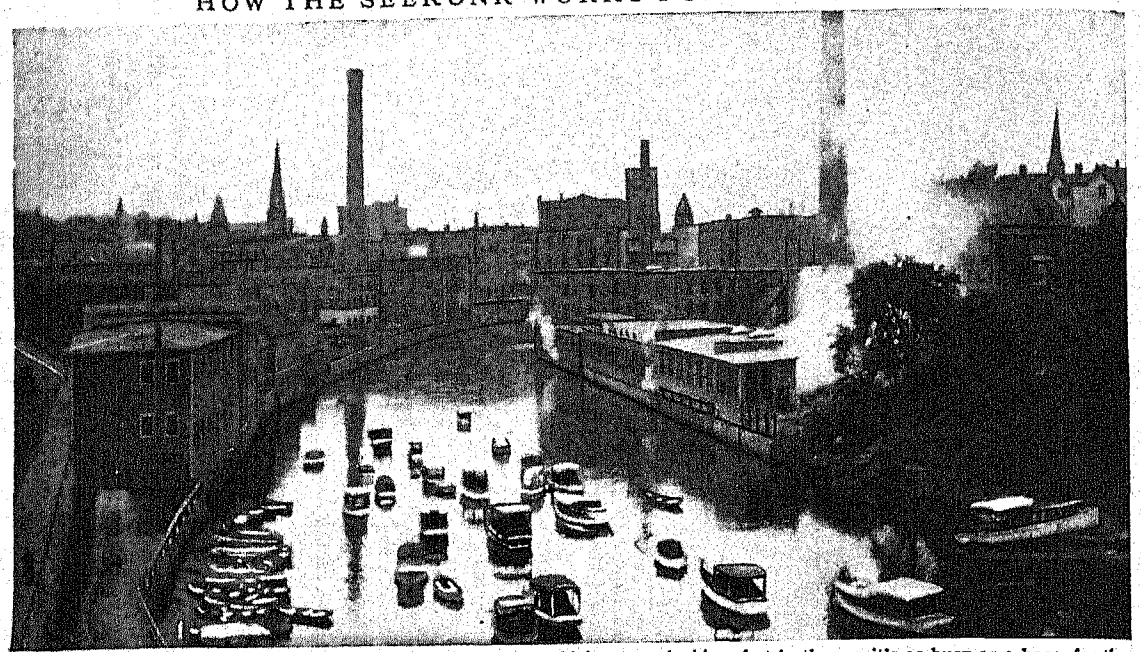
Have you ever seen the inside of a modern cotton factory? Try to imagine one of the operatives or even one of the foremen going to Greenland or to South Africa and trying to set up a cotton factory from memory—drawing patterns of all those beaters, cards, "mules," and whirling spindles, getting unskilled workmen to make them, even making many himself, and then teaching people who had scarcely dreamed of machines before how to run them.

You will then have a picture of the task of Samuel Slater when he came from England to Rhode Island, in 1789, to start a cotton spinning mill at Pawtucket. Of course his machines were simpler, and were run directly by a water wheel instead of by electricity; and he had been to some extent an inventor as well as a workman in Arkwright and Strutt's great pioneer factory back in England. But nevertheless a year passed before he had overcome the first mistakes and had accomplished the feat which others had tried and failed to accomplish. Owing to the strict secrecy preserved in England concerning the new spinning inventions, Slater had been unable to bring with him so much as a rough sketch; and indeed he had to dress as much like a farmer as possible, instead of like a mechanic, in order to leave the country at all. But by the end of 1790 he had his factory completed, and was producing a cotton yarn as fine as any spun in England. Today this smallest and most densely populated of states is the most highly industrialized state in the Union, with nearly 92 per cent of its people living in urban areas.

Although much of the cotton industry has moved to the Southern states, Rhode Island still produces fine goods in which style, beauty, and design are the principal requisites. Woolen and worsted goods are now far more valuable than cotton, and there are also large silk and rayon mills. A related industry is the manufacture of textile machinery. Other manufactures are fine jewelry and silverware, made in Providence since 1786, and rubber goods.

The rocky surface of the land and the large proportion of water area (156 square miles) make agriculture of little importance. Hay is the largest field crop. Farmers concentrate on commodities which may be profitably produced on a small scale and shipped to near-by markets, such as dairy products, fruits, vegetables, eggs, and poultry. The truck farms and nurseries around Providence are among the

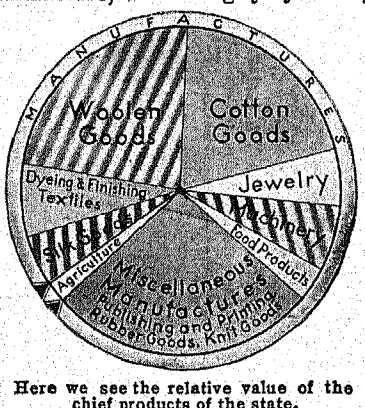
HOW THE SEEKONK WORKS FOR PAWTUCKET



Placid as a mill pond is the section of the Seekonk River at which we are looking, but further on it's as busy as a bee; for the power it provides when it plunges nearly fifty feet over a picturesque mass of rock runs some of the great mills for which the city of Pawtucket is famous. Above the falls it is generally known as the Blackstone River.

largest in the United States. The small but swift rivers, on the other hand, furnished the water power which gave the first impulse to manufacture; and now that coal has become more important than water, Rhode Island still has an advantage, for her position on the coast means cheap and abundant sea-borne coal.

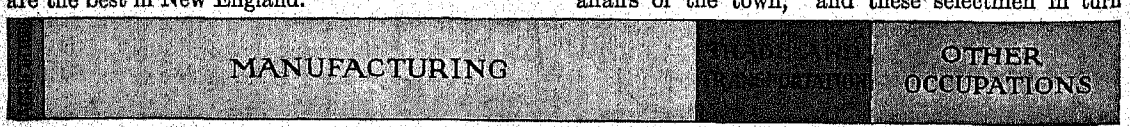
Narragansett Bay, with its good ports at Providence and Newport, meant commercial importance from the first. At the time of the embargo of 1807 and 1809, however, when ships rotted at their wharves all along the Atlantic seacoast, the shipowners took thought of Samuel Slater's factory at Pawtucket, and many turned their commercial fortunes to manufacturing purposes. The seacoast with its ponds, islands, and indentations multiplies about 20 times the coastal length as the crow flies. With Block Island, lying well out to sea, this means today not only commerce but fisheries. The traffic in shell-fish—lobsters, oysters, and clams—along Narragansett Bay is particularly important, and Rhode Islanders maintain that their clambakes are the best in New England.



Here we see the relative value of the chief products of the state.

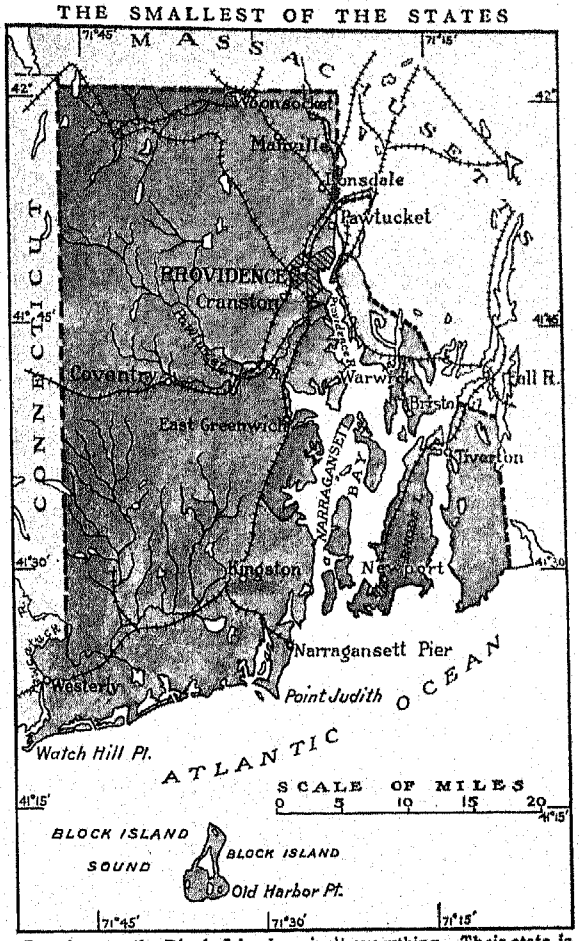
Imagine this busiest of modern industrial states, with its hordes of foreign immigrants, still governed largely by that typically colonial institution, the New England "town meeting." Every two years, when the governor and other state officers are elected, prosperous citizens and newly naturalized immigrants alike swarm by communities to their appointed central polling places. In local matters the towns are entirely governed by their town meetings. Fellow townsmen, as they get together to discuss things in meeting, and gather by groups outside when the meeting breaks up, or saunter away down the village main street by twos and threes, come to know each other unusually well.

In the old colonial days, when Providence had only one street, the town meeting was held every two weeks, and between whiles leading citizens came together informally to discuss things in John Smith's mill. The town meeting, presided over by a moderator, vested in a small number of "selectmen" the power of "ordering and managing the prudential affairs of the town," and these selectmen in turn



This Graph Shows the Relative Number of Persons Engaged in Various Occupations.

appointed special committees when necessary. The early towns were really little land corporations, and their sessions, at first taking the place even of the courts of law, have always held the local governmental power, notably in the raising of money for schools, poor relief and other necessary charges. It was discussion in town meetings that led Rhode Island, although first to declare independence, on May 4, 1776, to reject the Federal Constitution at first, and ratify it last of all the thirteen states (May 29, 1790), more than a year after that government had gone into operation. In 1832 Providence found the town meeting inadequate as its sole form of government and obtained a city charter. Once a year a town meeting is called to administer one of the funds, although it is said to be hard to get the quorum of 40 necessary for the task.



But size, say the Rhode Islanders, isn't everything. Their state is one of the richest and most densely populated regions in America.

Although Massachusetts was founded to escape religious persecution in England, Rhode Island was established by fugitives from the religious intolerance of the Massachusetts Puritans. Its first settlement, then called "Providence Plantations," was founded in 1636 by Roger Williams, who, with Anne Hutchinson, had been banished for holding doctrines opposed by the leaders of the colony. Anne Hutchinson and her followers founded Newport and Portsmouth. The first patent (1644) made "Rhode Island and Providence Plantations" a haven for religious refugees of all sorts. A later charter (1663) was the most liberal of all colonial charters and was so satisfactory that Rhode Island existed under it for nearly 70 years after the American Revolution. This charter gave suffrage only to men owning $134 worth of property, or to their eldest sons. This provision was not oppressive so long as all families owned land, but by 1840 a discontented propertyless class had arisen. In 1841, under the leadership of Thomas Wilson Dorr, the malcontents held a constitutional convention, drew up a new constitution based on the principle of universal manhood suffrage, and elected state officials under this consti-

This is the Capitol of Rhode Island, the prosperous little commonwealth affectionately known to its people as "Little Rhody." The Capitol is the finest building in Providence. It is built of Georgia marble and white granite. In the State Chamber is a famous full length portrait of Washington by Gilbert Stuart.

THE SUMMER PLAYGROUND OF AMERICA'S MILLIONAIRES

The Cliff Walk at Newport winds along the eastern shore of the island of Rhode Island—from which the state gets its name—for a distance of three miles. Back of it lie the magnificent summer residences which have made Newport world famous. If you should happen to be surf-bathing at Bailey's Beach just south of this walk, with a stiff southeaster blowing, you might think you saw a gigantic whale spouting. For near by is the Spouting Rock, which has an opening through which the water sometimes spouts up to a height of 50 feet when there is a gale from the right quarter.

tution. The old governing class, becoming alarmed, also held a constitutional convention and drew up a new constitution making many concessions. The rebels refused to withdraw their own constitution and government until Federal troops were called in and arrested Dorr as a traitor. He was sentenced to life imprisonment, but pardoned by the first legislature under the new constitution.

Until recently the Rhode Island constitution retained several unusual features. A property qualification for voters in towns and cities survived until 1929; and no town or city, regardless of its size, was allowed more than one member in the state senate. Providence, which has more than one-third of the total state population, now elects four senators. In the house of representatives each town or city is represented on the basis of population, except that Providence is allowed only one-fourth of the total membership.

Rhode Island claims to have performed the first overt act and to have shed the first British blood in the American Revolution when, in 1772, citizens of Providence burned the British armed cutter *Gaspee* which had been enforcing the revenue laws. The British occupied Newport from 1776 to 1779, and the French fleet made its headquarters there in 1780-1781. The French inaugurated the atmosphere of social gaiety which prevails even today in this summer playground of the country's millionaires.

Before the Revolution Newport (which lies on the island on Narragansett Bay from which the state gets its name) was an important commercial center. Its foreign trade rivaled that of New York and Boston. Today, however, it is chiefly famous as a summer resort, with its long line of costly summer residences stretching along the 12-mile Ocean Drive. The narrow streets and quaint old houses of the older part of town around the harbor contrast strikingly with the magnificent new homes of the summer colony. Other important cities, aside from Providence, are Pawtucket, which is practically a continuation of Providence, and Woonsocket—both famous for their cotton and woolen mills and other industries. (*See* Providence.)

Nathanael Greene, Rhode Island's most brilliant Revolutionary War soldier, was one of America's first great military leaders (*see* Greene, Nathanael). Commodore Oliver H. Perry, the "hero of Lake Erie," and his brother, Matthew C. Perry, who opened Japan to world commerce, also were sons of "Little Rhody." So also were Esek Hopkins, first commander of the American navy; Gilbert Stuart, noted for his portraits of Washington; and William Ellery Channing, eloquent preacher. Gen. Ambrose E. Burnside of Civil War fame was governor of Rhode Island from 1866 to 1868.

RHODES. A junk-dealer long ago hauled away the last fragments of the Colossus of Rhodes, the great bronze statue that was one of the seven wonders of the ancient world (*see* Seven Wonders). Children in the Street of the Knights swarm out of doorways carved with the arms of nobles of medieval Europe. Old men sit on stone stools that were Turkish cannon-balls. So life moves on in time-scarred Rhodes, capital of the mountainous island of Rhodes, farthest east of the Aegean isles. The island climate is refreshing, the soil rich. Peasants are happy with their fat cattle

and their good crops of olives, tobacco, grains, and fine grapes. The splendid climate and picturesque remains of crusader days attract many tourists.

Only ten miles from the coast of Asia Minor, the island has always been a key to the Near East. In ancient times it was a crossroads of the chief trade routes. The city of Rhodes was laid out in 408 B.C. and became an artistic center of the ancient world. But raids, sieges, and earthquakes ruined the powerful city. In A.D. 1309 it was seized by the Knights Hospitalers, a crusading order, who rebuilt and fortified it. In 1522 it was taken by Turkey and held till 1912, when it was occupied by Italy.

Rhodes is officially included by Italy in the archipelago known as the Dodecanese (Greek for "twelve islands"), although earlier geographers did not place it in this group. The group today includes 14 islands, of which Rhodes is the largest. As an Italian air and naval station, Rhodes was frequently bombed by the British air forces during the second World War. The island has an area of about 500 square miles and a population of about 45,000.

RHODES, CECIL JOHN (1853–1902). While making a solitary eight months' journey over the rolling "veld" of that part of South Africa which now bears his name—Rhodesia—Cecil Rhodes dreamed the dream which shaped all his future life. He was only 20 years of age at the time and had already won a fortune in the diamond fields of Kimberley.

CECIL RHODES
"A Builder of Empire"

A passionate believer in the destiny of the Anglo-Saxon race, Rhodes was impressed by the boundless possibilities of this undeveloped country and became fired with an ambition to "paint as much as possible of South Africa British red"—that is, to bring it into the British Empire. His dream did not stop there. He saw a vision of the English-speaking world—the United States and Great Britain with her far-flung colonies—welded together into an irresistible instrument to advance civilization and insure perpetual peace.

To this stupendous task all of Rhodes' energies were thenceforth devoted. He had the satisfaction of seeing part of his dream realized. He added 700,000 square miles of territory to the British Empire, and planned the Cape-to-Cairo railway to connect the Cape of Good Hope with the mouth of the river Nile. He did not live to see the federation of the states of South Africa, or to see the Anglo-Saxon peoples pour out their blood in a common flood to end the menace of German military autocracy.

Rhodes was born July 5, 1853, in the vicarage of a country parish, England. At 17, heart trouble forced him to give up his plan to go to Oxford University. He joined a brother in South Africa just in time to join the rush to the newly discovered diamond fields, equipped with bucket and spade and several volumes of the Greek classics. Within a few months he had made a fortune. His head was not turned, as would have been the case with many a boy, nor did he feel that he was beyond the need of further schooling.

This vigorous life so improved his health that he was able to take up his work at Oxford. For eight years he alternated between the University and South Africa. In 1881, just before taking his degree, he was elected to the parliament of Cape Colony, and in 1890 he became its prime minister.

Rhodes was then virtually dictator of South Africa. Few men in modern times have wielded such power. In addition to his political power, through his vast business interests he controlled the great consolidated diamond and gold mining interests of the country, and was managing director of the gigantic British South Africa Company, which he had formed to develop the territory that so struck his youthful imagination. Disaster came six years later, in connection with the ill-fated raid of Dr. L. S. Jameson in aid of a revolution to overthrow the backward Boer government in the independent Transvaal Republic. Cecil Rhodes was forced to resign the premiership and give up control of the South Africa company because it was proved that he had aided this movement.

One of the most picturesque incidents in Rhodes' colorful career came a few months later, when the Matabele natives revolted. Attempts to suppress the rebellion proved futile. Rhodes pitched camp, unprotected, at the foot of the impregnable Matoppo hills where the natives had retreated, and patiently waited. His courage so amazed the chiefs that they started coming in for parleys. Finally a conference was arranged in the fastnesses of the hills. Rhodes and three companions rode unarmed into the midst of the chiefs, heard their grievances, promised redress, and the rebellion was over. He re-entered the Cape Parliament in 1898 and had made some progress toward regaining his old power when the Boer War (1899–1902) began.

Upon the outbreak of the conflict, Cecil Rhodes hastened to Kimberley, where he took an active part in defense of the town and mines. Privations and incessant labor during the siege broke his health, and he died March 26, 1902. He was buried, as he desired, in a tomb hewn in the granite of the Matoppo hills.

Always a great reader, Rhodes once said that his life had been more influenced by one sentence of Aristotle than by almost anything else. In his own paraphrase, the sentence is this: "The greatest happiness in life is to be derived from the conscious pursuit of a great purpose."

Rhodes bequeathed the bulk of his huge fortune for the endowment of about 175 scholarships at the University of Oxford, to be held for two or three years by selected students from every important British colony and from the United States. Fifteen scholarships were also allotted to Germany

The scholarships originally were fixed at £300 a year, but were later raised to £400 (normally about $2,000).

In normal times, thirty-two scholarships are assigned to the United States—four annually to go to each of eight districts. Candidates must be male citizens of the United States, unmarried, between 19 and 25 years of age, and must have completed at least the sophomore year at some recognized degree-granting university or college. They may apply either from their home states or from any state in which they have received at least two years of their college education. Each college or university is entitled to appoint from one to five candidates. From these the state committees of selection nominate two candidates each, and district committees make the final selection on the basis of: (1) qualities of manhood, force of character, and leadership; (2) literary and scholastic ability and attainments; (3) physical vigor, as shown by interest in outdoor sports or in other ways. Those appointed to scholarships may elect any course of study at Oxford for which they are qualified by their training. If they desire they may spend the third year of the scholarship in postgraduate work in some other university.

RHODODEN'DRON. Throughout June and July the gorgeous blossoms and shining foliage of the broad-leaved rhododendron shrubs and small trees beautify the mountain slopes of eastern North America. The flowers are carmine, lilac-colored, or purple.

The species usually found in the East is the American, or great, rhododendron. The Carolina, or Catawba, rhododendron grows in the high Appalachians. One species is found on the Pacific coast; and many additional kinds flourish in Europe and Asia, especially in the Himalayas, Borneo, and Java.

Rhododendrons are cultivated widely as garden shrubs. Many hybrid or grafted rhododendrons develop more beautiful flowers than do native species. The plants flourish in moist but well-drained peaty soil. Rhododendrons belong to the heath family and are akin to the azaleas. Because they contain a resinoid called andromedotoxin they are poisonous.

Scientific name of the great rhododendron, often called the rosebay rhododendron, *Rhododendron maximum*. Flowers rose-pink, varying to white, greenish in throat and spotted with yellow and orange; grow in clusters from conelike bud. Leaves evergreen, drooping in winter, lance-shaped or oblong, dark green. Some treelike species are from 40 to 60 feet high; shrub forms may attain a height of 20 feet. Scientific name of the Catawba species, *Rhododendron catawbiense;* of the western species, called the coast rhododendron, *Rhododendron macrophyllum*.

RHONE RIVER. Since the earliest days of civilization this picturesque stream which enters the Mediterranean near Marseilles in France has been one of the principal avenues of commerce leading from the Mediterranean across what is now France to the Rhine on the one side and to the coasts of the North Sea on the other. Phoenician traders received the tin of Britain by this route; the Romans made of it the avenue of Caesar's conquests; Saracen bandits, crusades, and commerce poured along this way in the Middle Ages; and today its long strip of navigable waters and the canals which connect it with the Loire, the Seine, and the Rhine make it one of the great water routes of Europe.

Springing as a torrent from the foot of a great glacier high in the Alps of southern Switzerland (nearly 6,000 feet above sea level), and swollen by many mountain streams, the Rhone dashes down through wild gorges and flows southwestward through the broad beautiful valley between the Bernese Alps (north) and the towering Pennines (south). Picturesque old villages and thriving little towns cluster along its banks, and in the distance Great St. Bernard and the Matterhorn look down upon it from a dizzy height, as it rushes swiftly through this beautiful mountain region. At Martigny, 75 miles from its source, the river turns sharply to the northwest and, flowing through a wide marshy plain, pours into the Lake of Geneva. There it leaves all the impurities gathered in its turbulent course through the mountains, and issues from the southwestern extremity of the lake limpid and clear as crystal. But half a mile below Geneva the Arve River that descends from the glaciers of the Mont Blanc range pours its turbid waters into the Rhone. Twelve miles west of Geneva the Rhone enters French territory and rushes through narrow gorges around the southern spur of the Jura Mountains, receives from the north the waters of the Ain, and then flows freely westward to Lyons. Thus far a huge and unruly mountain torrent, it there receives the Saône, its principal tributary, and turning southward becomes one of the great historic rivers of France, flowing through a land of romance and poetry, of vine and olive, and of old Roman temples and papal palaces. Between Lyons and the sea, a distance of 230 miles, the steep slopes above the river are everywhere covered with rich vineyards. Along its left bank lie such historic cities as Vienne, Valence, Avignon, Tarascon, and Arles, and on that side the Isère, the Drome, and the Durance rivers, bringing down the melted snows from the lofty Dauphiné Alps, add to it their waters. On the right the Ardèche is the only important tributary. About 25 miles from the Mediterranean the Rhone divides into two main branches—the Grand Rhone running southeast and the Petit Rhone southwest—and thus discharges its waters into the sea.

The total length of the Rhone is a little more than 500 miles, of which Lake Geneva claims 45. The headwaters of the Saône, which rises in the Vosges Mountains in northeastern France and flows 301 miles southward to meet the Rhone, might well be considered as the headwaters of the latter stream, for its course is much more direct than that of the upper Rhone. Canals branching off from the course of the Saône connect it and the Rhone with the basins of the Loire, the Seine, the Rhine, and the Moselle. The Rhone-Marseilles Canal, leading from the Rhone, at Arles, to the seaport Marseilles, is one of the chief outlets for the river commerce of France. At Rove, this canal flows underneath the Nerthe Hills through the huge Rove Tunnel, which is 72 feet wide, 50 feet high, and nearly 4½ miles long.

RHUBARB. Pie and the acid fruit-flavored sauce made from the long juicy leaf-stalks of the rhubarb or "pieplant" are among the earliest gifts of the garden in the spring. When a few rhubarb roots have

been set out in the garden, practically no more attention need be given the bed, for it will renew itself year after year and the stalks are simply pulled from the low crown of the plant as needed. Rhubarb requires a rich soil, however, and the wise gardener will force early growth by putting fertilizer around the roots in the spring. Placing an old bushel basket, half barrel, or other cover over the plants causes the leaves to shoot up rapidly in search of light and thus produces longer stems that are especially succulent and tender.

Rhubarb is a member of the dock family, and has large heart-shaped leaves, sometimes a foot across. Cultivation has greatly improved the plant, making the stems less woody, with thinner skin and better flavor than the stems of the wild plant. In spring the skin is flushed with red that adds attractive coloring to the light green sauce. Scientific name, *Rheum rhaponticum*. The roots of certain species are sometimes employed in medicine for their cathartic and tonic properties.

The RICE PLANT *and the* PADDY FIELDS

The Little Mud-Pie Farms of Oriental Lands—The Sowing, Cultivation, Harvesting, and Threshing of the White Grains that Feed One-Half of All Mankind

RICE. It is a hot sultry day in faraway Japan, exactly the sort of weather that suits the moisture-loving rice plant. On the top of a little mud wall around a small field stands a thin yellow-skinned man, clad only in black cotton trousers and a big woven reed hat that looks much like the lid of a huge cooking pan. He is a Japanese farmer—patient, hard-working, and usually hungry.

"MAN POWER"

He leans his weight on a wooden crosspiece in a queer kind of rectangular framework that rests on the top of the wall; with his feet he operates a treadmill which turns a water-wheel with

Here and there in the rice fields of Japan and China you will see men at work like squirrels in a cage, patiently turning wheels that lift water into the rice fields.

little cups or paddles set in its circumference. This raises the water from the ditch below and spills it into the field, which looks just now much like a big mud-pie.

Tomorrow the tiny rice plants will be transplanted into this "paddy" field which is being made ready so carefully. Three or four weeks ago the seed was sown broadcast in a smaller muddy field, much like this one, and then covered with water.

Very early next morning the whole family arrives—father, mother, the older children, and perhaps some outside helpers, three or four chubby little roundfaced babies, and grandpapa, who has come along for an outing. Barefooted and with trousers rolled to the knees, all but the babies and grandpapa wade into the oozy mud and begin setting out the young plants in rows about 18 inches apart. The last part of the day's task is to flood the field, for growing rice prefers to spend most of its life in the water. That is the reason the fields must always be walled. Before long this little plot, covering not more than two or three acres at most, would remind you of a field of young oats, if you didn't catch the gleam of the water in between the stems.

Then the Weeding, More Watering, the Harvest

Hot wet weather makes weeds also grow rapidly. Sometimes the natives wade into the water and pluck out the weeds with their toes as neatly as you could with your hands; but usually each time weeding is needed the field is drained.

Then there's more work at the treadmill, until there is again enough water in the field to float the leaves. When the leaves begin to change from green to yellow the water is drawn off for the last time. The grain then ripens rapidly in the sun. Some varieties mature in three months, others require from four to six.

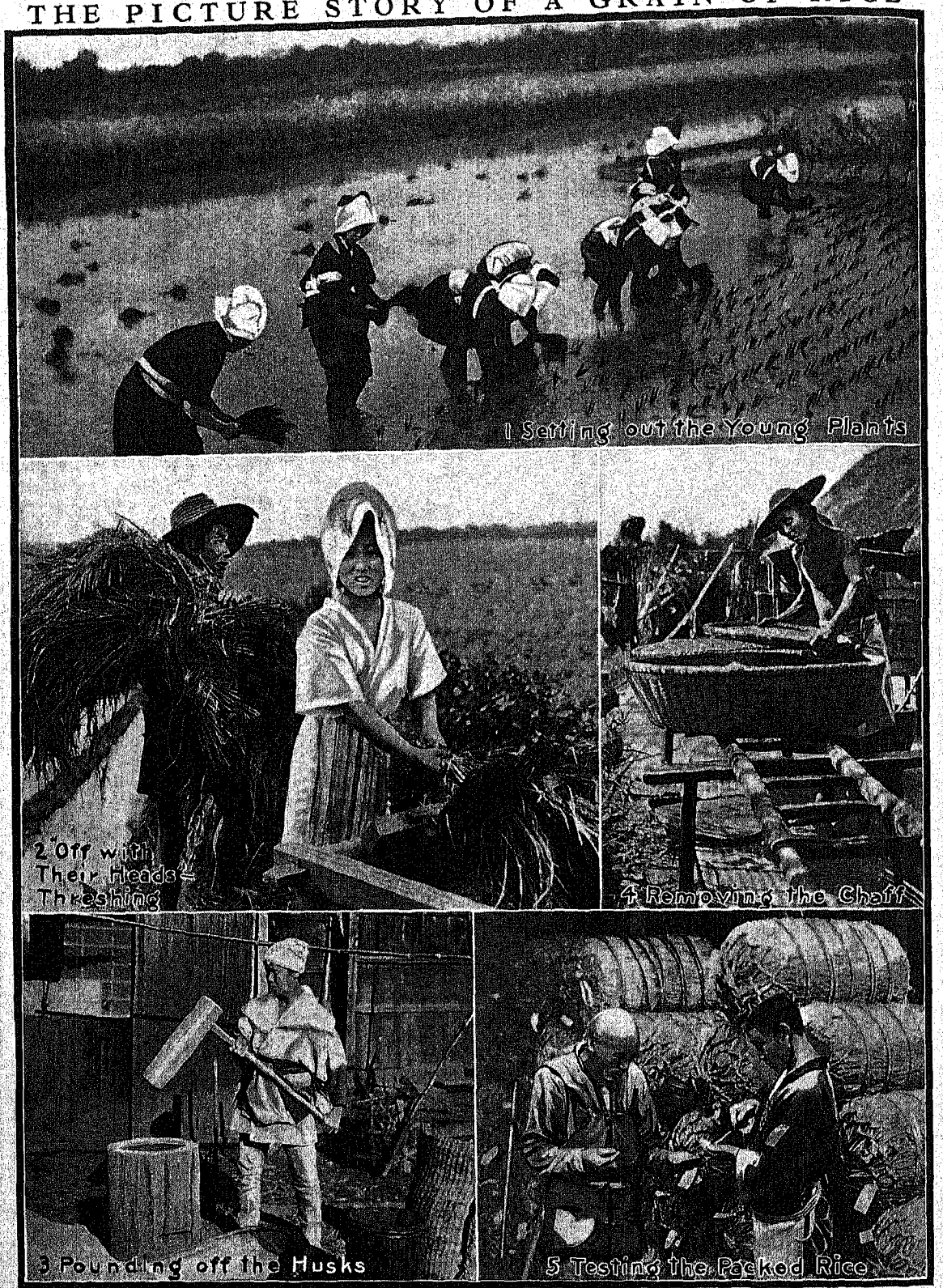
In Japan machinery has no part in the harvesting of this crop. The straws are cut with a hand-sickle, a handful at a time. Threshing is very simple, just pulling the heavily laden heads through a saw-toothed frame placed over a tub or cask. The Japanese, who have learned to waste nothing, use the straw for making hats, sandals, matting, and bagging. The roots are burned and return to the field as fertilizer.

To get rid of the outer husk the grain is beaten with flails. The tight-fitting inner covering is then loosened in little hand-mills. For long hours at a time women and children squat on the ground shaking the mixed grain and chaff up and down and to and fro in shallow reed baskets, that the wind may blow away the chaff.

Rice Growing around the World

Rice is the principal food of at least one-half the human race. It is grown most profitably and easily on low river flats subject to frequent inundations which leave behind them a deposit of rich alluvial soil. For that reason it is the main crop along the lower Yangtze in China, the lower Ganges in India, the

THE PICTURE STORY OF A GRAIN OF RICE



Here we see how the patient laborers of Japan, working by methods that seem primitive to Occidental farmers, cultivate, harvest, and prepare for market the great staple food of the Orient. And yet methods like those shown above are used for about 95 per cent of the world's rice crop. The world grows enough rice in a single year to fill about seven billion bushel baskets.

delta of the Irrawaddy in Burma, in Siam and French Indo-China, and along the Nile in Egypt. These districts also possess the other requisite for successful rice growing, a long, warm, growing season. This lowland rice is called "wet" rice. Another important kind, called "dry," or "upland," rice, is grown on mountain slopes where the crop can be irrigated. Little terraces like shelves are leveled off and the water is dropped in ditches from one level to another.

The growing of rice has had an important effect on the civilization of the natives of southeastern Asia, who are much farther advanced than the people of other tropical lowlands. Rice farmers, who usually own their land, must live in permanent villages and coöperate with their neighbors in controlling the water supply; they must also work hard in planting and harvesting their crops. They have therefore developed a type of peaceful and conservative community life that is not found among the forest peoples of the tropics.

Rice has been grown in the United States since colonial days, but its production on an extensive scale is comparatively recent. The yield per acre is high—higher than the yield of wheat and other grains, and with modern irrigation methods and modern machinery to plant, cultivate, and harvest the crop, rice-growing has become a profitable industry in Louisiana, Texas, Arkansas, and California. American rice is exported to more than 50 countries in some years.

Southeastern Asia, however, still raises about 95 per cent of the world's rice supply. China is the chief producer, followed by India and Japan. The other leading producers are Burma, French Indo-China, the Netherlands Indies, and Siam. But only Burma, French Indo-China, and Siam normally grow enough for export. Despite their own tremendous production, China, India, Japan, and the Netherlands Indies usually must import large quantities of rice.

Rice (*Oryza sativa*) is one of the most important of the cereal grasses (*see* Grasses). As a food it is inferior to wheat, having less protein and fat. In milling, rice is first cleaned and then passed between hulling stones which crack the hulls and free the inner grain. At this stage the germ and outer bran skin have not been removed from the kernels and the product is called "brown rice." It is rich in fat, minerals, and vitamin B, while the polished rice is almost entirely starch. Eastern peoples who live chiefly on rice eat the brown rice because a diet of polished rice may produce a disease called "beri-beri."

Wild rice, which grows in Canada and the northern United States, is an entirely different plant (*Zizania aquatica*). It was a favorite food of the woodland Indians and is marketed on a small scale today in the United States.

ENGLAND'S RICHARDS, *Good and Bad*

RICHARD, KINGS OF ENGLAND. It would be hard to find more widely contrasting types than the three Richards who have sat on the English throne.

RICHARD I, called the Lion-Hearted (*Coeur de Lion*), who ruled from 1189 to 1199, was more than six feet in height and fair-haired and blue-eyed. As his nickname shows, he was a splendid fighter, the greatest of his day. He was a poet also, and men loved to hear him sing; but as a king he was too careless of his duties to be called a great ruler.

Richard grew up wholly under French rather than English influences. Both his parents, the energetic Henry II and the forceful and passionate Eleanor of Aquitaine, were of French birth and education. His father was the first Plantagenet king of England, but his possessions in France were greater than all England. French was the language of the Plantagenet court, where gay troubadours and minstrels were always welcome. French was Richard's native tongue, and almost all his life was spent in France; even after he became king he made only two brief visits to England.

At the age of 15 Richard was formally placed in charge of his mother's duchy of Aquitaine, in southern France. Next year he joined his brothers, aided by the French king, in a widespread but unsuccessful revolt against their father (1173). He also engaged in struggles with his elder brother Henry and his younger brother John. The death of his brother Henry (1183) made Richard the next heir to the throne to which he succeeded on the death of his father in 1189.

News of the recapture of Jerusalem by the Mohammedans, two years before, had stirred all Europe, and great preparations for the Third Crusade were already on foot. For Richard this proved the great undertaking of his life. After a brief visit to England, to be crowned and to provide for the raising of money for the government in his absence, Richard returned to the Continent to complete his preparations. The English fleet sailed by way of Gibraltar to Marseilles, while Richard journeyed overland to the same port. He joined King Philip of France at Sicily, where they wintered and quarreled violently. Richard again turned aside on the way to the Holy Land to fight with the ruler of Cyprus. He finally joined Philip at the siege of Acre, which surrendered in July 1191.

Because of his military skill and courage, Richard was soon acknowledged as chief leader of the crusade. King Philip shortly returned to France, to plot against his rival. For more than a year Richard remained in Palestine. When he fell ill of fever it is said that his great opponent, Saladin, the chivalrous leader of the Mohammedans, sent him fruit and snow. "He was brave," says an Arab writer, "experienced in war, and fearless of death. If he had been alone among millions of enemies, he would not have declined battle; when he attacked there was no resisting." Twice the crusaders were within two days' march of Jerusalem, but were unable to take that holy city. At last Richard negotiated a truce for three years, under which the Christians might safely visit the Holy Sepulcher; and then sailed for home, in October 1192.

King Philip and Richard's brother John were plotting desperately against him, and when Richard was forced to land at the head of the Adriatic Sea he found himself a hunted man. In the disguise of a merchant he reached Vienna, the home of his worst enemy, Leopold, Duke of Austria. When detected, he was arrested and imprisoned. A beautiful story tells how his minstrel Blondel discovered his whereabouts by singing under the windows of many castles until he heard the imprisoned Richard's reply.

Money for Richard's ransom was finally raised and he was released in February 1194. Hastening to England, he found John's attempted revolt already crushed. John himself was forgiven. The remaining five years of Richard's reign were spent in constant fighting with Philip, and building with great engineering skill his "Saucy Castle," the Chateau Gaillard in Normandy. The government of England was left chiefly to administrators trained by his father, Henry II. Richard died as he had lived, fighting. While besieging a castle in southern France, he was wounded by a cross-bow bolt in the shoulder, and died in consequence a few days later. Even during his lifetime Richard's deeds were the subject of song and story. In later times they have been treated by Sir Walter Scott in his novels 'Ivanhoe' and 'The Talisman'. A truer picture of Richard is given by Maurice Hewlett in his novel 'Richard Yea and Nay'.

The Temperamental Richard II

RICHARD II (1377–1399) was the son of the "Black Prince," who fought so courageously at Crécy and Poitiers in the reign of Edward III. The death of his grandfather Edward III, following that of the Black Prince the year before, made Richard king when he was only a boy of ten. His character and his reign were full of contrasts. At one time he faced a mob with courage and coolness; at another he would give way to furious fits of passion, throwing his hat and boots out of the window or slapping the face of the archbishop of Canterbury. At one period he ruled with great moderation and won popularity; at the end of his reign he threw moderation to the winds, and ruled so tyrannically that he was deposed.

During the minority of Richard there were quarrels between the great nobles who struggled for power and there were religious dissensions growing out of the teachings of John Wyclif (*see* Wyclif, John). There was also a formidable Peasants' Revolt in 1381, in which, according to one account, the 14-year-old king rode boldly forth to confront the angry rebels, when they found themselves betrayed and their leader slain, crying: "What need you, my masters? Would you shoot your king? I will be your captain." (*See* Tyler, Wat.)

It would take too long to tell in detail the story of the political struggles which filled the remainder of Richard's reign—of how Parliament appointed a commission to guide the king's rule; how the judges declared that the leaders of Parliament had committed treason; how those leaders raised an army and defeated the king's forces, and the "Merciless Parliament" then hanged or exiled the king's friends; how the king suddenly declared himself of age, ruled wisely for eight years, and then suddenly changed and put to death or banished his worst enemies; and how he surrounded Parliament with his archers and compelled it to grant him greater powers than any other English king had ever had.

This triumph but paved the way for his downfall. Richard's cousin, Henry of Bolingbroke, son of John of Gaunt, Duke of Lancaster, was one of the opponents whom Richard had banished. In 1399 he returned to England with a few followers to recover his inheritance, which Richard had unjustly seized. His followers rapidly became an army and Richard II was forced by Parliament to resign the crown, which was then conferred upon Henry of Bolingbroke, the first of the Lancastrian kings (*see* Henry, Kings of England). The deposed king was kept for a time in London Tower, and then removed to the castle of Pontefract, in Yorkshire. When a rebellion broke out in his favor, in January 1400, Richard was murdered in his prison, though it was given out that he had died a natural death.

The Crimes of Richard III

RICHARD III (1483–1485) was a Yorkist prince who was so ruthless and unscrupulous that his character is painted in the blackest of hues. In after times Shakespeare in his 'Richard III,' represented him as physically crook-backed and morally a monster. It is true that Richard's left arm was withered, but he was of average height and build, with the left shoulder slightly lower than his right, nor was he bad looking. He was well knit and more than a match in battle for many a man taller and heavier than himself. He grew up, however, in the midst of the civil strife which preceded the bloody Wars of the Roses, and at a time when the tyrants of Renaissance Italy were setting examples of government by intrigue, poison, and assassination. While naturally calculating and distrustful, Richard could be very engaging. He was able and hardworking, but his merits, such as they were, have largely been forgotten because of the way he won his crown.

When his brother, Edward IV, died, Richard of Gloucester (as he was then called) saw a chance to win the throne. Already he was suspected of murdering the Lancastrian Henry VI and the latter's son to secure the crown for Edward IV. Suspicion also pointed to him as the slayer of his brother the Duke of Clarence. Now there stood between Richard and the throne only the two little sons of Edward IV, the eldest of whom, Edward V, was not 13 years old. Richard secured control of both boys and had himself declared Protector by the council. He then spread charges that the late king's marriage had been illegal and that his sons therefore had no right to rule. A packed assembly summoned in place of the regular Parliament thereupon asked him in 1483 to take the crown as Richard III.

Installed as king, Richard III sought to make himself popular, but it was noted that those who stood in his way were soon got rid of. First it was Lord Hastings, an old officer of Edward IV's, who was accused of plotting and instantly executed. Then the two uncles of the little princes, brothers of their mother, were put to death on charges of treason. Finally the two little princes themselves, whom Richard had imprisoned in the Tower of London, disappeared, and it was rumored that they were murdered. Twenty years later one of Richard's agents confessed that he had caused them to be strangled; and in 1674 two skeletons corresponding in size to the little princes were found secretly buried in the Tower.

The disappearance of these two young princes turned the great mass of Richard's subjects against him. For two years he maintained himself upon the throne, but he lived in uneasy fear, and his hand was always on his dagger when he rode abroad. An uprising headed by the Duke of Buckingham failed, and that leader also perished on the scaffold.

Then in 1485 Henry Tudor, Earl of Richmond, who as the last male representative of the Lancastrians had a claim to the throne, prepared an expedition in France which landed in the west of England and rallied supporters to him. Richard advanced to meet the invader at Bosworth Field. Although a portion of his troops withdrew or went over directly to the enemy, Richard fought with terrific courage. Deserted, and surrounded by his enemies, he struggled on until he fell pierced with wound upon wound. That same day the victorious Tudor was crowned Henry VII, with Richard's battered crown, picked up from the battlefield. (*See* Edward, Kings of England; Henry, Kings of England.

RICHARD'S FIRST VIEW OF THE HOLY LAND

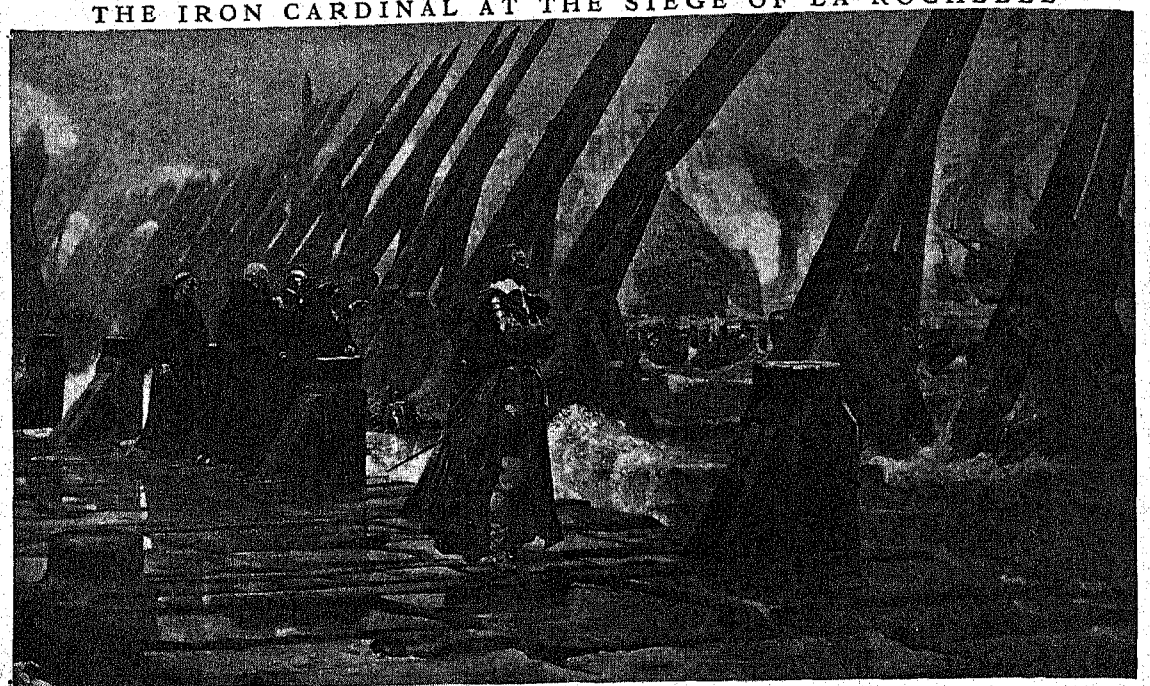
With his famous sword raised in an attitude of consecration, Richard of the Lion Heart is here looking for the first time across the plain to the Holy Land, where he performed such prodigies of reckless valor.

RICHELIEU (*rēsh'ĕ-lų*), CARDINAL (1585–1642). No more striking figure can be found in all the dramatic history of France than that of Armand Jean du Plessis, Duke of Richelieu, who, as a cardinal of the Catholic church and chief minister of state, controlled for nearly 20 years the destinies of France and raised her to the position of the foremost power in Europe. Haughty, stern, ruthless, implacable, the great Cardinal is a figure that kindles the imagination and has been the theme of countless paintings, dramas, and romances. Even when sickly and wasted with disease, such was the force of his will and the majesty of his bearing that he over-awed all, including the king. He loved the privileges and trappings of power, living in royal state, and forcing even princes to yield him place. Not even the most powerful noble in the realm dared to stand against him. Every whisper of plot or discontent was brought to him by his scores of spies, as well as all that was said and done in every salon of Paris and in every court of Europe.

Through the influence of powerful friends Richelieu became a bishop at the age of 21, and a cardinal at 37. His attention to the affairs of a small bishopric, however, did not interfere with his watchful search for a larger field of endeavor. He was ambitious for political power and preference, and he did not disdain to fawn upon queen and courtier to gain his ends.

His ambition was realized in 1624, when he became chief minister of France. From that time until his death he was so completely master of France that he quite obscured the personality of the weak king, Louis XIII, whose chief claim to greatness lies in the fact that he kept his great minister in power regardless of personal dislike and court intrigues.

THE IRON CARDINAL AT THE SIEGE OF LA ROCHELLE



The inflexible resolution with which Richelieu carried out his designs is well exemplified by his stubborn siege of La Rochelle, the chief stronghold of the Huguenots. To take it, he had to cut off the town from aid by sea, by building the great stone mole you see in the picture, a mile long and guarded by a floating stockade. In spite of the desperate energy of their resistance and the aid of English troops, the people of La Rochelle had to capitulate after a year's siege in which they were reduced to eating even the straps of their sword belts.

When Richelieu entered the royal service he aimed, as he once told Louis, "to employ all my efforts and all the authority which it might please you to give me, to ruin the Huguenot party, to lay low the pride of the nobility, and to raise your renown among foreign nations to the point at which it ought to be."

What Richelieu set out to do, he accomplished. In 1628, after a year's siege, he took from the Huguenots the town of La Rochelle, their principal fortress. This marked the end of their political power, although they still retained freedom of worship and civil rights.

To humble the nobles was a more difficult task, but the ruins of many of the medieval castles throughout France testify to the thoroughness with which Richelieu carried out his work. All fortified places not necessary to repel invasion he ordered to be dismantled or destroyed. He also appointed royal officers to oversee the governors of the provinces and bring them under the control of the king.

Aids German Protestants

The opportunity to carry out his third design was furnished him by the religious and political wars of Germany. (*See* Thirty Years' War.) Although a staunch Catholic and a cardinal of the church, Richelieu did not hesitate to aid the Protestants of Germany in their struggle against Spain and the emperor, at first by furnishing their ally, Gustavus Adolphus of Sweden, with financial aid, and later by engaging actively in the conflict. By this policy France was, at the conclusion of peace in 1648, the foremost power in Europe. Especially she had added to her domains the territory Alsace, which later became one of the "lost provinces," restored to her by the World War of 1914–18.

Richelieu did not live to see the conclusion of the Thirty Years' War, but his work was ably carried on by his follower, the wily Mazarin. The war had cost France immensely in men and money, and when Richelieu died he was the most hated man in the country. Humiliated noble and tax-burdened peasant joined in bonfire celebrations of their release from the tyrannical minister, yet the French people now esteem him as one of the greatest of their rulers. "His fame," says one writer, "is cherished because he secured for France glory and power, and a foremost place among European nations."

Richelieu also made himself an imperishable place in the literary annals of France by fostering the great writers of his day, and by founding the French Academy. (*See also* Gustavus Adolphus, King of Sweden; Huguenots; Louis, Kings of France.)

RICHMOND, VA. Almost any street in Richmond, capital of Virginia, recalls some colorful episode in American history. The same street is likely also to bear witness to the city's rapid industrial growth. Situated at the head of navigation on the James River, 90 miles from the sea, Richmond is the chief manufacturing city of Virginia and a distributing center for a large area of the South.

So numerous are the monuments of Richmond's storied past that they themselves tell the city's history. A large stone cross stands on the hill where Capt. John Smith claimed the land for England in 1607. William Byrd Park, a lovely 300-acre recreation center, is named after Colonel Byrd, who selected the site for the city in 1733. In 1737 the city was settled by Maj. William Mayo, who named it for its similarity to Richmond on the Thames, in England.

In 1779 Richmond became the capital of Virginia. The capitol building was erected (1785–92) from a plaster model, which Thomas Jefferson helped to design, of the Maison Carrée, a Roman temple in Nîmes. This stately building was the scene, in 1807, of Aaron Burr's trial for treason; in 1861–65 it housed the Confederate Congress. Under the dome of the capitol is Houdon's statue of Washington. In St. John's Church Patrick Henry cried to the Virginia Convention, "Give me liberty or give me death!"

As the capital of the Confederacy, Richmond remained one of the chief objectives of the Union commanders until Grant's capture of its lines of supply compelled Lee to evacuate it, Apr. 3, 1865. To prevent great quantities of tobacco from falling into the hands of the Federal forces, the warehouses were fired, and nearly 1,000 buildings in the heart of the city were burned. In Hollywood Cemetery, Jefferson Davis and Presidents Monroe and Tyler are buried beside 18,000 Confederate dead.

Blending the Past and the Present

After the war the people of Richmond energetically rebuilt their city to fit into modern industrial America. But they were careful to preserve the beauty and charm of a city which, like Rome, rises on seven hills over the countryside. And they were ever mindful of their rich tradition of history and culture. To ride today along Monument Avenue is to pass in review the statues of Virginia's most distinguished sons. Among the many museums are the Virginia Museum of Fine Art; the Confederate Museum, a treasure house of Confederate relics; and the Confederate Memorial Institute ("Battle Abbey"), which contains many fine portraits of Southern heroes. The Old Stone House (built in 1686) is now a museum devoted to the memory of Edgar Allan Poe. Still preserved are the homes of Jefferson Davis, Robert E. Lee, and Chief Justice Marshall. The University of Richmond, the Medical College of Virginia, and the Virginia Union University for Negroes make the city an educational center.

"Tobacco Row," spreading a fragrant scent from its factories, is the center of Richmond's leading industry, the manufacture of cigarettes and other tobacco products. Among the other chief manufacturing establishments of the city and its suburbs are paper mills, iron and steel works (the Tredegar Ironworks supplied cannon for the Confederacy), publishing and printing houses, and chemical factories turning out chiefly rayon and cellophane. Richmond is the reserve city for Federal Bank District No. 5. Since the completion of a deep-water terminal in 1940, the port of Richmond can accommodate commercial vessels of almost any size. Between the terminal and the ocean, the James River has been deepened and improved with cut-off canals. Population, 193,042.

RIDDLES. "In at every window and every door crack, round and round the house and never a track." Can you guess this riddle? Your grandmother at your age probably guessed it and her grandmother before her. These puzzling questions called riddles have always been popular; and the wind has always been a favorite subject. The Wolof natives of Senegal put it in this way: "What flies forever and rests never?" The German riddle runs, "What can go in the face of the sun and leave no track?"

Riddles, like fables and folk stories, belong to all races and ages. Their guessing is an ancient game in which high prizes and heavy forfeits have been paid. The Bible has many of these old-time riddles. You will find them among the proverbs of Solomon, and in the fourteenth chapter of Judges there is a curious story of the riddle that Samson proposed to the Philistines. Among the ancient Greeks, also, the riddle was popular. It is found in the writings of their famous poets. Homer himself, legend says, died of chagrin because of a riddle that he could not guess. Among the well-known myths of Greece is the story of the Sphinx, a strange monster that crouched on a hill above the city of Thebes, waiting to kill men who passed by if they could not answer this riddle, which she put to them: "What is that which has four feet in the morning, two at noon, and three at night?" At last after many of his countrymen had perished because they could not guess it, there came Oedipus, who answered, "Man. As a baby he creeps on hands and knees, in mid-life walks on two feet, in old age totters along with the aid of a cane, or third leg." An ancient Norse myth tells of a riddle contest where the daughter of Thor was the prize. In the Middle Ages riddles were used merely as a pleasant pastime. Some have come down to us in an old collection called 'Amusing Questions'. It is well that solutions also are given, for who could guess such a riddle as "What is that that never was or never will be?"—the answer to which is, "A mouse's nest in a cat's ear."

Pun riddles are among the cleverest proposed today. "What is it that is black and white and red all over?" If "red" is spelled *read* it will give a clue, for the answer is "A newspaper."

The conundrum is first cousin to the riddle. It is founded on some odd resemblance between unlike things or their names. "What kind of fruit does the electric plant bear?"—the answer being "currents." Or, "When is a door not a door?"—to which you reply, "When it is ajar" (*a jar*).

RIGA (*rē'gȧ*), LATVIA. Founded by German merchants of the Hanseatic League in the Middle Ages (1158), this city at the head of the Gulf of Riga—an arm of the Baltic—still has the air of a medieval

German city, with its high warehouses, spacious granaries and cellars, flanking narrow winding streets. In contrast, the suburbs are quite modern, with their wide boulevards and parks, apartment houses, and cafés. Life in Riga is active, although the city has lost much of its former bustling prosperity. Many of its plants and factories were destroyed in the first World War, and some were never rebuilt. Before the Russian Revolution of 1917, Riga was the trade link between Germany and the rich basins of the Dnieper and the Volga, with which it is connected by a system of inland canals. During Latvia's short period of independence between 1918 and 1940, Riga was its capital. In 1940, however, the country was incorporated into the Union of Soviet Socialist Republics.

The harbor is not well protected, and is closed by ice in winter. The exports are largely timber, flax, meats, and dairy products; the manufactures are wood-pulp, cellulose products, paints, and textiles. Besides the Latvian University, there are technical schools, an academy of fine arts, and one of music. The population, made up chiefly of Letts, Russians, Jews, and Germans, is about 380,000.

RILEY, JAMES WHITCOMB (1849–1916). This American poet who wrote of childhood with such tender pathos and humor was like Robert Louis Stevenson in having the vivid memory of his own earliest years that enabled him to interpret the impressions, feelings, and whimsical fancies of children. When he was over 40 years old he collected in 'A Child World' those of his poems which described the simple pleasures of his boyhood life in Greenfield, Ind., where he was born. And in that region of cornfields, meadows, woodlands, and orchards, there were many people who remembered the sturdy, flaxen-haired little boy with wide-open blue eyes who had been known affectionately as "Buddy" Riley. An active, daring, exploring little fellow, first to venture into "the old swimmin' hole" which he celebrated in verse, he was a leader in boyish sports. And because of his odd notions, gift of mimicry, and friendliness with babies, grandmother's hired men, and dogs, he was a welcome guest in farmhouses. But nobody, not even "Buddy" himself, dreamed that he was taking notes, when he listened to the pithy talk of older people in that racy "Hoosier" dialect of the pioneer days of the Middle West.

When Riley's village schooldays were done it was intended that he should study law in his father's office, but the adventurous youth ran away with a traveling patent medicine and concert troupe. He soon abandoned that shabby business to support himself by honest sign-painting; but by having to write "catchy" songs and to act in farcical little plays to hold the street crowds for the medicine peddler, he discovered his literary and histrionic talents. At 20 a poem contributed to a local paper brought him into newspaper work. Writing under the name of "Benjamin F. Johnson, of Boone," he won a delighted and growing audience for his dialect verse.

The best of his verse was admirable. As unerringly and lovingly as Burns in the Scottish lowlands, the "Hoosier poet" had caught the idiom of his own people and given to it a universality of experience and feeling. Riley was not limited to dialect, for he wrote in exacting forms of English verse with imagination, melody, and finished art; but he ranks with Bret Harte and a few other gifted Americans who created a distinctly native literature. He gave expression to an interesting and typical local condition of society that has now passed away. Dramatic abilities that would have won success on the stage he used in public readings from his own works, making them more widely known and admired.

Up to old age he kept the flaxen hair, wondering blue eyes, and ingenuous look of boyhood; and when he read about "Little Orphant Annie" or "The Raggedy Man," the "Buddy" Riley he used to be came back to his face and voice, and won all hearts. A people's poet, of genuine gifts and appealing personality, Riley became the literary idol of Indiana. In his later years the school children of the state capital celebrated his birthday by marching in procession and leaving flowers at his home.

Riley's poems, complete in six volumes, were published in 1913. His best known books are 'The Old Swimmin' Hole' (1883); 'Afterwhiles' (1887); 'Pipes o' Pan at Zekesbury' (1888); 'Old-Fashioned Roses' (1888); 'Rhymes of Childhood' (1890); 'Green Fields and Running Brooks' (1892); 'Armazindy' (1894); 'A Child World' (1896); 'Rubaiyat of Doc Sifers' (1897); 'Home Folks' (1900); 'An Old Sweetheart of Mine' (1902); 'Out to Old Aunt Mary's' (1904).

RIO DE JANEIRO (*rē'ō dā zhà-nā'rō*), BRAZIL. In all the world there is perhaps no more picturesque and charmingly located port than Rio de Janeiro, the capital of Brazil and the second greatest city of South America. Steaming into its harbor, you see a gigantic cone of rock—the celebrated "Sugar Loaf" (*Pão d'Assucar*)—which guards the entrance on the left, and you gaze with interest at the odd aerial trolley which carries passengers thither in cars swinging high in the air. On the right, hardly less impressive, is the frowning mass of rock called Pico. Passing these you come suddenly into the pear-shaped bay, studded with lovely islands and surrounded by a wall of mountains of fantastic shape, most of them covered with tropical vegetation. All the navies of the world could ride at anchor in this huge bay. Curving around its western shore, on a long but narrow strip of land between the blue waters and the overhanging hills, lies Rio (as it is familiarly called), a radiant city of white spires and domes.

Leaving the steamer at the dock, you find yourself facing a stately thoroughfare with rows of royal palms and walks of fanciful mosaic designs, lined with great buildings of solid construction and modern architecture. Later you will motor to the end of this avenue, marked by the wonderful palace named after President Monroe of the United States, and there turn into the Beira-Mar, a famous boulevard which follows the line of the bay for many miles. The many parks

are brilliant with tropical flowers which in more temperate climates are raised in hothouses. Palms wave their branches 150 feet above the ground, and tall bamboos interlock their feathery arms over the walks and shield pedestrians from the heat of the sun. Especially interesting are the Botanical Garden, where flowers from all parts of the world are cultivated, and the "Hunchback," or Corcovado, a hill whose summit you will ascend to enjoy the magnificent view.

This new Rio has arisen as if by enchantment from the old-fashioned city which visitors knew years ago. Since 1903 it has been largely rebuilt, at enormous expense. Sanitary reforms have transformed it from a port dreaded by seafarers, because of the prevalence of yellow fever, to one of the most healthful of tropical cities. The harbor, naturally one of the finest in the world, was dredged to make a broad shipping channel along the face of the new great stone quay, deep enough for the largest steamers. Hundreds of buildings were torn down in the business section at the same time to widen the streets.

The city derives its chief importance from commerce. Coffee is the principal export, and imports consist chiefly of food and manufactured articles. The most important industries are flour and textile mills.

According to Portuguese writers, the name Rio de Janeiro ("River of January") was given to the bay by a Portuguese captain who entered it in January 1502, and thought it to be the mouth of a large river. Population, about 1,800,000.

RIO GRANDE (*rē'ō grän'dā*). Rising in the snows of the Rocky Mountains, and forming for hundreds of miles the border line between the United States and Mexico in its lower course, the Rio Grande is a stream of singular interest, both because of its geographic position and because of the colorful and contrasting phases it presents in its 1,800-mile course from southwestern Colorado to the Gulf.

It has often been the cause of international dispute since it was designated as part of the boundary line at the close of the Mexican War. Its shifting current and the diverting of water from its lower course for irrigation projects nearer the headwaters have caused frequent contention. Trouble has also arisen because of the fact that for months in the year it shrinks to such small proportions that in many places it can be forded on foot or horseback, and smugglers and bandits find no difficulty in crossing from one country to the other. United States troops, stationed at Fort Bliss, El Paso, and other border towns, keep a constant outlook for offenders, and the "line riders," mounted custom inspectors, watch the trails and passes in wild stretches of country.

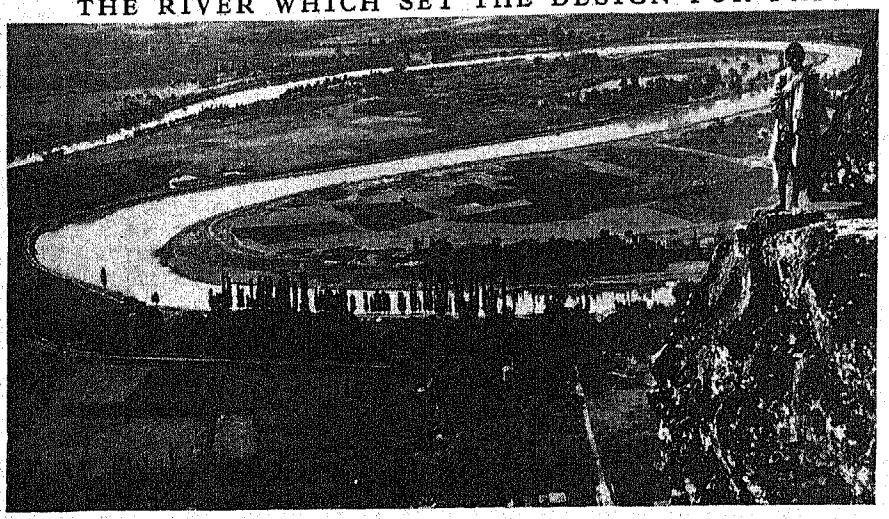
The Rio Grande—the "big river," as its Spanish name means—exerts a powerful influence on the land it passes through. In some places it has made rich alluvial valleys; in others it plunges through picturesque rock-bound canyons, leaving the land on either side a desert. Where the yellow turbulent Pecos, its main tributary, pours into it near the town of Del Rio, there is a canyon hundreds of feet deep worn in the solid rock. For a large part of its journey along the border it pushes through yielding yellow sand, twisting and doubling on itself. Like the Mississippi in its lower reaches, the Rio Grande is constantly changing its course by wearing off an angle of land on one side of the river, and depositing the soil on the other side, or by cutting through a small neck of land, leaving a little half-moon of a lake as the only indication of its former course. But the boundary line, according to treaty, still remains at the center of the shifting current, and any land that the river in its vagaries deposits on its northern shore is under the jurisdiction of the United States, and additions to the southern shore line belong to Mexico.

The greater part of the Rio Grande basin lies in an arid region, and its waters were being used by the Indians for irrigation when the earliest explorers visited the country. The river overflows if heavy rains come when it is filled with melted snow from its mountain sources, and great dams have been built to conserve these flood waters for the dry seasons. Elephant Butte Dam, 120 miles above El Paso, Tex., is one of the largest irrigation reservoirs in the world. Enough water is stored to irrigate 4,000 square miles of land or to cover 2,500,000 acres a foot deep. Another project, organized by the state of New Mexico and the Federal government, is the El Vado Reservoir on the Rio Chama, a tributary of the Rio Grande above Albuquerque.

The United States and Mexico agreed, by a treaty ratified Nov. 10, 1933, to straighten the Rio Grande where it forms the border between the two countries. The project included the construction of a flood-retention dam and reservoir at Caballo, N. M. This improvement would help to eliminate annual floods.

RIVERS AND INLAND WATERWAYS. The tremendous importance of rivers to man is seen in the great agricultural populations which their valleys and flood plains support, and in the numberless cities that have grown up on their banks to take advantage of the transportation and water power which they offer. Their importance in nature is no less conspicuous. They drain the land of its surplus water and with it they carry to the sea billions of tons of rock and mud and minerals. They are more important than all other agents in shaping land surfaces. They cut up high plateaus, creating magnificent rugged mountains; and in the course of ages they drop these mountains, bit by bit, into the sea. Aided by weathering, every river system is engaged in the task of carrying to the sea all the land of its basin which is above sea level; but few if any rivers actually reach that goal, for the river itself passes through a cycle of evolution, from youth to old age. As it gradually cuts down its steep slope, it changes from a rapid stream in a narrow valley to a wide sluggish one with little erosive power; and it may take as long to wear away the last few feet above sea level as all the other thousands of feet.

THE RIVER WHICH SET THE DESIGN FOR PAISLEY SHAWLS



In the vale of Kashmir (Cashmere) in the northernmost part of India, winds the Jehlam River, as we see here. Its beautiful curves suggested to the weavers of Kashmir the graceful loop design used in Paisley shawls. The river flows by Srinagar, the capital of Kashmir, and past the 1,000-foot hill at the right, called the Throne of Solomon. On this hill is the temple made famous by Thomas Moore in his poem 'Lalla Rookh'. The Jehlam is a typical "meandering river," so called from the river Meander, now called the Menderes, in Asia Minor. About 25 miles below Srinagar the Jehlam expands and forms the Wular lake and marsh. The Kashmir Valley is a noted health resort.

The *bed* of a stream is the surface upon which it flows, and its *banks* are the sides which hold it in bounds. A *river system* includes a main stream and its branches, or the tributaries which flow into it. A *river basin* is the territory drained by the river and all its tributaries. A *divide*, or *watershed*, is the high land between two rivers which causes the ground water to flow toward both streams. Where a river enters the ocean on a sunken coast line, the sea backs up into the mouth and it becomes a "drowned" river; a V-shaped bay, called an *estuary*, is thus formed. Many important harbors are large estuaries.

We commonly speak of only one "source" of a river; but a well-developed river system has as many sources as a tree has branches, all of which ultimately reach the trunk that empties into the sea. The water of rivers, furnished by rain and snow, comes at first from the sea by evaporation, or in less degree from lakes and other rivers. When rain falls on an uneven slope it is gathered into many little rills which follow the depressions in the surface, and immediately gorge making begins. Much rain, especially upon level ground, soaks into the soil, but later seeps into the rivers which have cut their channels deep enough, or comes up to feed streams in the form of springs. Those rivers which do not have access to ground water have usually only an intermittent flow, unless their sources are in snow or ice fields or lakes.

A Rushing Start and a Placid Finish

At its source in the mountains the bed of a stream is steep and the swift river tears away everything that is in its path, causing rapids where it rushes over a rocky bed, or high waterfalls when it tumbles over cliffs. As the river leaves the mountains, however, the gentler slope of the land makes it less rapid and gives it power to carry only small stones, gravel, and mud. Near the ocean the slope of the bed diminishes still more, and the valley becomes a wide plain in which the river swings to right and left in great curves or "meanders" (so called from the river of that name in Asia Minor), laying down most of the burden which it gathered in the mountains. As the flowing river unites with the standing water of the sea, even the finest mud sinks to the bottom, and a plain is built up called a "delta," from its resemblance to the Greek letter Δ. At times of heavy rains, or in the spring when the snow melts rapidly, the shallow channel in the lower course of a river is unable to contain all its water, which then spreads over the surrounding country like a vast sheet. When the water subsides it leaves a thin layer of sediment behind, which in time builds up a broad flat "flood plain," like that along the Nile and the Mississippi, where the soil is extremely fertile. High levees are often built along such rivers to protect the surrounding country; but such control cannot be permanently successful, for the sediment of the river raises its bed above the surrounding country, and in time the water overflows the levees. The Yellow River in China, called "China's sorrow," is thus constantly changing its channel.

Such is the typical river, of which there are many variations. Where the movement of the land is downward there are no deltas, but drowned river valleys, as in northeastern America. Floods cannot occur on rivers like the St. Lawrence, which have their flow equalized by lakes. In arid countries many rivers do not empty into the ocean, but end in deserts where they sink into the ground or evaporate.

In the history of America, the rivers have played an important part. The streams were the gateways that allowed the early explorers and the colonists to penetrate the continent, for on land they were confronted by thick and almost trackless forests. Thousands of hunters entered the interior by the rivers and lakes to obtain furs.

In colonial days the rivers served a double purpose, enriching the soil for the farmer and providing a means of transporting his products to points from which they could be shipped to Europe, thereby

saving the heavy expense of overland freighting. When small mills began to take the place of the home in manufacturing, the rivers and streams took on another important economic aspect, becoming the sources of power for the factories. These waterways also affected social conditions, for they made communication easier, and settlements naturally grew up about shipping and manufacturing points.

The completion of the Erie Canal aided the growth of the West in days before the railroads were built. During the early years of the railroads, waterways lost their importance, but recently the cheapness of water transportation has caused renewed interest.

Great American Waterways

Perhaps the most important inland waterway in North America today is the Great Lakes-St. Lawrence system, including the canals at Sault Sainte Marie (one on the Canadian and two on the American side of the St. Mary River) and the Welland Canal. This system, jointly developed by the United States and Canada, may some day be deepened until great ocean liners can come all the way up the Great Lakes to Chicago and Duluth. (*See* Canals; Great Lakes; Sault Sainte Marie; Welland Canal.)

A second great development is the Mississippi River system. A six-foot channel is complete in the Mississippi from Minneapolis to St. Louis and, in the Missouri, from Sioux City to the Missouri-Mississippi junction. A nine-foot channel runs from Pittsburgh down the Ohio to the Mississippi and on down to New Orleans.

The Great Lakes-St. Lawrence system and the Mississippi system are connected through the Illinois Waterway system. This leads from Lake Michigan through the Chicago River, the Chicago Drainage Canal, the Des Plaines River, and the Illinois River to the Mississippi River near Alton. This waterway was completed in 1933 by coöperation of the Federal government and the state of Illinois.

Waterways Along the Coasts

Also counted as inland waterways are the coastal bays and canals along which small boats can pass through protected waters from Boston to Florida by way of the Cape Cod Canal, the Chesapeake and Delaware Canal, the Chesapeake and Albemarle Canal, and the Dismal Swamp Canal. A similar intracoastal system follows the Gulf coast from Apalachicola, Fla., to Corpus Christi, Tex. The two may some day be connected by a canal through Florida.

Of the 25,000 miles of river classed as navigable and therefore under federal control, about 4,000 are now actually usable. Plans call for an expansion to about 9,000 miles. Along these waterways barges, steamboats, and even small passenger vessels can travel. (*See also* Floods; Physiography; Valley; and articles on important rivers.)

GOOD ROADS *and* CIVILIZATION

Close Relation between Highways and Human Progress—The Paved Streets of Babylon, and the Magnificent Roads that Led to Rome—Indian Trails and Turnpikes—How the Automobiles Help—Streets and Street Paving

ROADS AND STREETS. Roads have been called a symbol by which the progress of a community can be measured. If people have no roads, they are savages; and if their roads are poor and little used, it is a sign that their civilization is stagnant. For "if there is any motion in society, the road, which is the symbol of motion, will indicate the fact." Without them commerce is impossible, and large cities cannot exist; communities are isolated, and interchange of ideas cannot take place. Roads are, indeed, not only the sign of civilization—they are one of the chief means for its advancement.

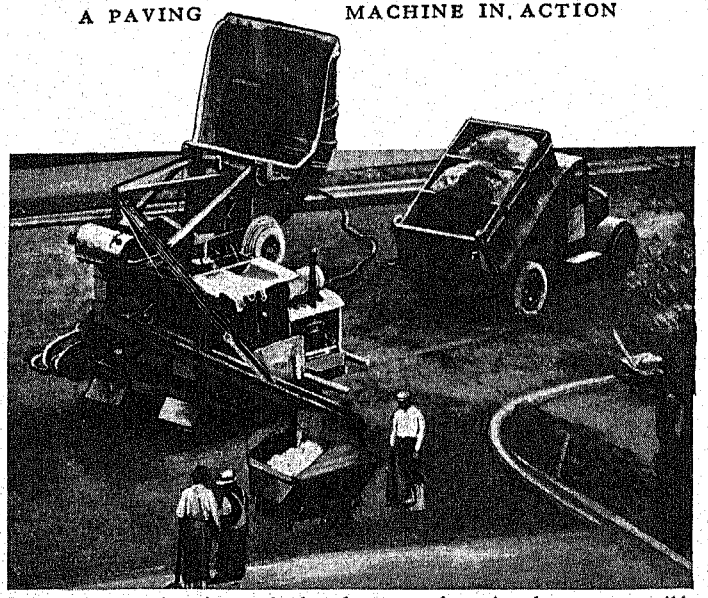
The importance of roads to the welfare of nations was not unknown to the ancients. The city of Babylon was paved as early as 2000 B.C., and Herodotus speaks of a magnificent Egyptian road which was built to assist in the construction of the Great Pyramid. The Peruvians, Chinese, and Carthaginians were also great road builders; but beyond question the greatest road builders of the ancient world were the Romans, whose stone-paved highways are the most solid structures in the way of roads found in any age. "All roads lead to Rome" was then literally true, for that city was the center of a network of wonderful highways reaching from the remote east to the farthest west, and even penetrating England. Many of them still remain as great monuments to the energy and skill of their builders, forming the foundation of modern roads and in some instances constituting the road surface now used.

In the Middle Ages the magnificent Roman roads were allowed to decay, and for over a thousand years none were built to take their place. The medieval traveler had to force his way through deep and miry lanes at a pace of two or three miles an hour, in constant fear of being stuck fast in some quagmire or overturned. Even in the time of Queen Elizabeth the only safe means of travel was by horseback or on foot. When stage-coaches were finally introduced (about 1659) Macaulay tells us that "it happened almost every day that coaches were stuck fast, until a team of cattle could be procured from some neighboring farm, to tug them out of the slough." As late as 1770 Arthur Young complained of a Lancashire road that its ruts actually measured four feet deep, and "a thousand to one break their necks or their limbs by overthrowings or breakings down. The only mending it receives is tumbling in some loose stones, which serves no purpose than jolting the carriage in a most intolerable manner." Small

wonder that many people lived and died without traveling 20 miles from their place of birth!

In America Indian trails were for a long time the only means of travel except by water. As the population pushed inland these trails were generally widened into roads for the use of wagons, but they long remained in an intolerable condition. One of the most popular means of improving them was to place trunks of trees across the mud roads and leave them to settle there, producing what was called a "corduroy" road. Dickens describes vividly a journey over one of these in his 'American Notes' (1842): "At one time we were all flung together in a heap at the bottom of the coach; at another we were crushing our heads against the roof. Now one side was deep in the mire, and we were holding on to the other. The very slightest of the jolts with which the ponderous carriage fell from log to log was enough, it seemed, to dislocate all the bones in the human body."

A PAVING MACHINE IN ACTION



Four times as much paving can be done by a gang of men in a day as was possible before the machine at the left was invented. The apron on the "paver" is lowered to receive a batch of cement, sand, and crushed stone from the "batcher" truck on the right. Rising, the apron pours the batch into a mixer, to be mixed with water to make concrete. A bucket on the swinging monorail arm spreads the concrete; it is leveled by men with shovels, and finished by another machine.

As trade increased, better roads were demanded, and privately owned toll-roads, or turnpikes, were built. The name "turnpike" came from the road between Philadelphia and Lancaster, on which long poles armed with sharp spikes stopped the traveler at toll stations. The poles were turned aside after payment, hence, *turn-pike*. These were the first improved roads in America.

These private toll-roads were not popular, but they increased very rapidly. Before the beginning of the 19th century England had 30,000 miles of them, and after their introduction into America in 1790 the people invested in the stock of the turnpike companies a sum almost equal to the country's debt at the close of the Revolution. Since timber was plentiful in America, plank and corduroy roads were those most often built. Little improvement was effected in road-building until the 19th century, when two skilled engineers, Thomas Telford and John L. MacAdam, introduced scientific road-building in England. The latter's name is commemorated in our macadamized roads, which, as Dickens said, have benefited "our shops, our horses' legs, our boots, and our hearts."

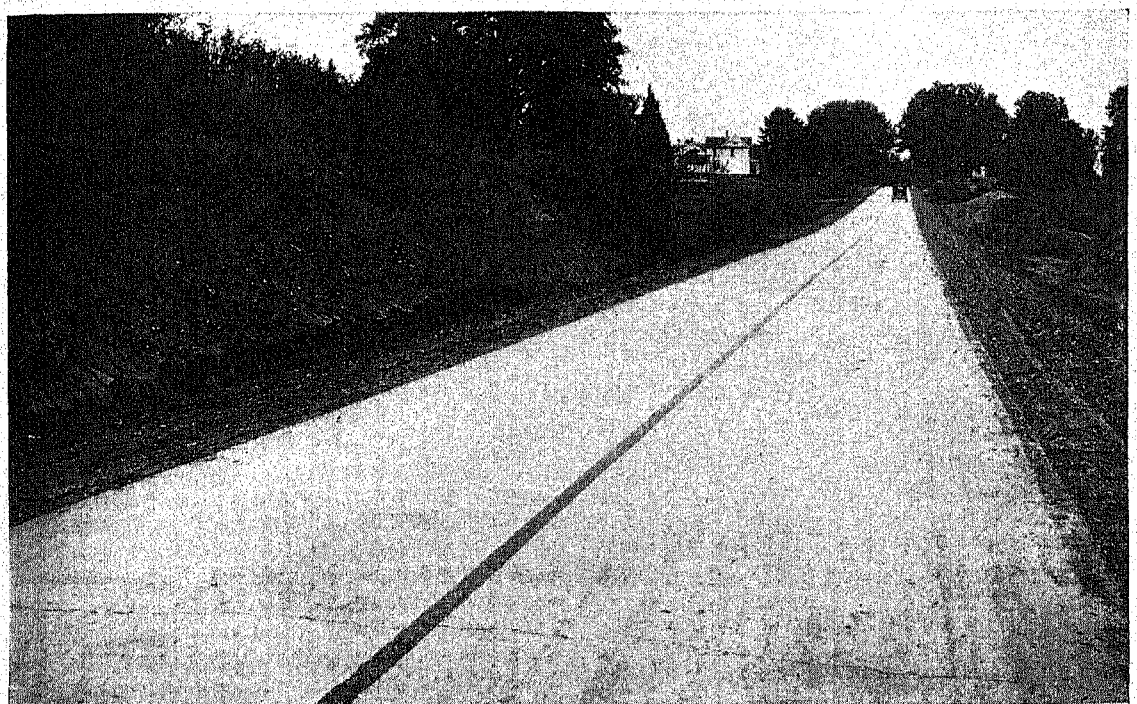
Road-building remained a purely local and usually private affair in America until 1806, when Congress began the famous National Pike or Cumberland Road to furnish better communication between the East and West. At a cost of $7,000,000 a great highway 800 miles in length was gradually constructed from Cumberland, Md., to Indianapolis, beyond which it was only partially completed. Thousands of prairie schooners followed it into the West, and it was one of the most important steps in national expansion. But with the coming of the railroads, Federal as well as state aid in road-building ceased for nearly half a century, because it was thought that roads would never be used for any but local traffic.

It remained for the automobile to give the next great impetus to the cause of good roads. There were almost 3,000,000 miles of highway in the United States in 1900, but only a few hundred miles were surfaced, and these were mostly in large communities. It was said the country never would have many automobiles, because there were such few roads fit to run on. The early motor tourist adventurous enough to try to cross the continent met meandering old trails which, owing to years of disuse, were practically impassable. Time had all but blotted out the historic highways over which moved the commerce of the great West before the coming of the transcontinental railroads. Farming communities were indifferent or even hostile to road-building and its expenses. But with the advent of the automobile, the motor truck as well as the pleasure car, city and country alike awoke to the importance of good roads. Today the country is interlaced with a system of fine highways, some of which follow the routes of the old historic roads. The modern Old Trails Road, for example, includes the Cumberland Road in the east and uses part of the Santa Fe Trail to the southwest. And U. S. Highway 1, which runs from the Maine border to the tip of Florida, includes portions of the old Boston Post Road and the King's Highway.

Pioneers among the noted roads of today were the Dixie Highway from Chicago to Florida and the Lincoln Highway, 3,270 miles long, between New York

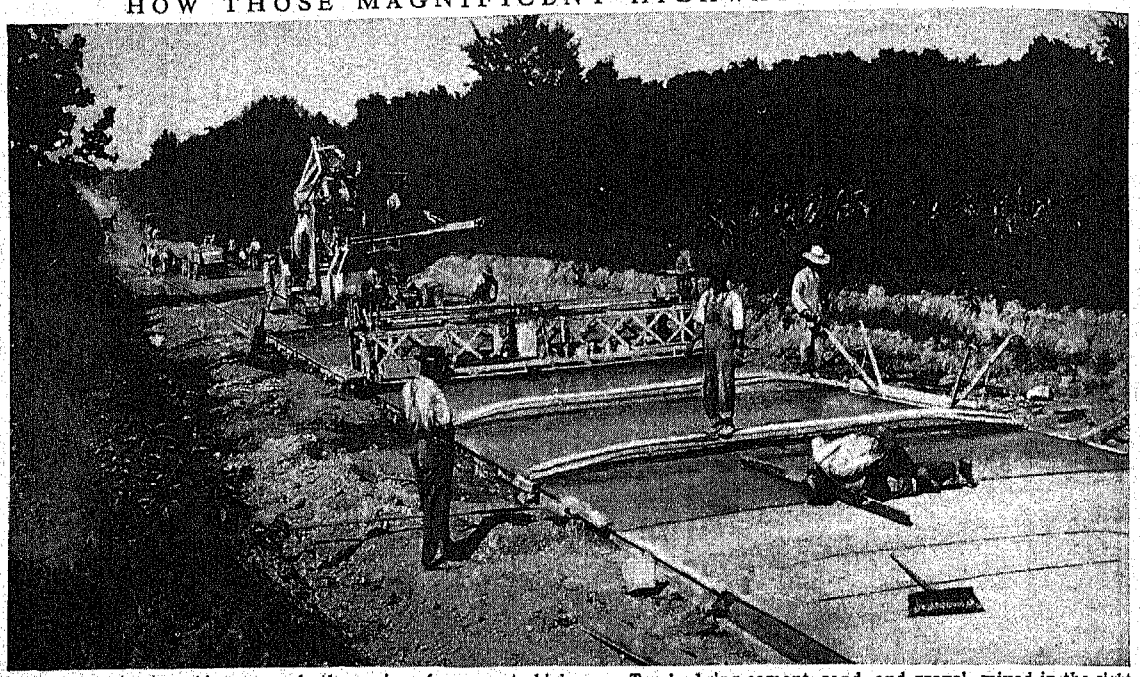
THE SAME OLD ROAD, BUT WHAT A CHANGE!

Such roads! Such roads! In dry weather you were choked with dust, and after a heavy rain the mud was so deep that, likely as not, your car would get stuck and you would have to pay a farmer to bring his team and pull you out. And think of the poor farm horses straining up hill and down dale with a heavy load that just had to be got to town, no matter how bad the roads were! This is the way most of our country roads looked a generation ago. But along came the automobile, and then—



Just look at the change! It's the same old road, as you can tell by the house and the trees; but hills and valleys have been graded out, and a concrete pavement has been laid over which automobiles and motor trucks can dash along at 30 or 40 miles an hour in all sorts of weather all the year round. The farmer is no longer isolated for weeks at a time. It used to take him perhaps an entire day to get to the nearest town and back. Now he makes the round trip in a couple of hours.

HOW THOSE MAGNIFICENT HIGHWAYS ARE MADE



Here we see how machinery speeds the paving of a concrete highway. Trucks bring cement, sand, and gravel, mixed in the right proportions, to the huge mixer; on the nearer side, the mixer pours out concrete. A finishing machine, which runs on the rail-like side forms, compacts the concrete; the surface is smoothed by hand tamping. Expansion joints are left at intervals, and are filled with bituminous material; the man kneeling over a spirit level is checking the work across such a joint.

and San Francisco. The Lincoln Highway was the first road to be marked from coast to coast. Many roads are noted for the beautiful scenery along their routes or for the engineering difficulties that were overcome in building them. Among the latter is the Columbia Highway along the Columbia River in Oregon. It is paralleled on the Washington bank of the river by the Evergreen Highway. Another remarkable engineering feat is the Pikes Peak Highway, up the north side of the mountain.

One of the country's finest modern roads is the magnificent Pacific Highway, which runs from Vancouver, B.C., to the Mexican border beyond San Diego, Calif. A continuation of this road in Mexico will ultimately connect with the Pan-American Highway, a still more ambitious project. It is planned to run from Alaska to the southern tip of South America, passing Santiago, Chile, and Buenos Aires, Argentina. A section of the Pan-American Highway between Laredo, Tex., and Mexico City was opened in 1936. The United States has aided Central American construction on this road, especially in bridge building, with grants of money and engineers.

Federal, State, and Local Roads

Great activity among the states in road building resulted from the Federal Road Act, or Tice Law, of 1916, which provided about $75,000,000 for building roads outside cities. This sum was to be apportioned among states which contributed amounts equal to the federal funds they received. An act passed in 1921 authorized the secretary of agriculture to lay out some 200,000 miles of highways throughout the country and to pay half the construction cost from federal funds. State highway commissions coöperated in selecting routes. Thus the interests of both interstate travel and local use were protected. These roads are known as Federal or United States highways; the east-west ones are known by even numbers and the north-south ones by odd numbers. They are constructed by the states, following plans approved by the Public Roads Administration in the Federal Works Agency.

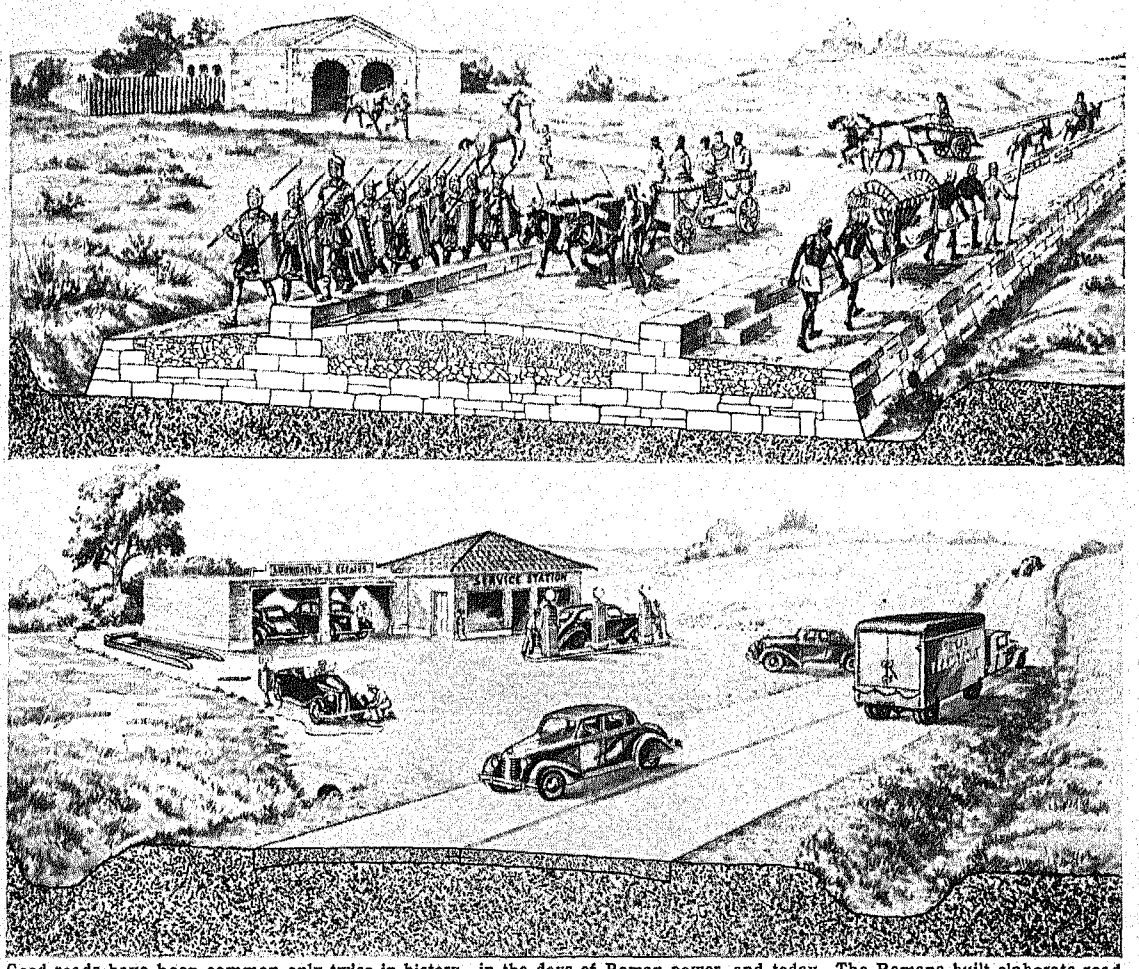
The states also build many roads with funds obtained by gasoline taxes or by issuing bonds which are paid off with gasoline taxes and license fees. And they aid counties and cities with their road building.

The network of through roads consists of more than 200,000 miles of federal-aid highways and about as many more miles in state systems. In 1934 the Hayden-Cartwright Act directed that at least one-fourth of federal road appropriations be used for secondary "farm to market" roads, a measure which the National Industrial Recovery Act had authorized in 1933. In 1935 a restriction limiting federal aid to $15,000 a mile was removed, and the use of federal money for roads within cities was authorized.

Extent of the Road and Street Problem

In spite of the extensive road-building programs of the Federal and local governments in the past decades, much still remains to be done. The United States has more than 3,000,000 miles of roads of all types. A nation-wide survey of roads and traffic needs was begun with federal aid, under the Hayden-Cartwright

HOW A ROMAN ROAD COMPARES WITH A MODERN HIGHWAY



Good roads have been common only twice in history—in the days of Roman power, and today. The Romans built elaborate road beds with stone, gravel, lime, and hand power; we build simpler beds with concrete and machines. The Romans provided fresh horses at post or relay stations; we provide gasoline stations. Note also that the Romans, like modern builders, understood the need for crowned surfaces and good drainage to side ditches, and how foot travelers used the shoulders and curbs of the road.

Act, to determine the accurate mileage for each type. Only slightly more than one-sixth of these roads have good paving. Many of the paved roads need enlarging, better bridges, wider curves, and grade separations to speed traffic and increase safety. And there is the additional problem of improving some 2,000,000 miles of earth road. Improvement and extension of city streets present another problem, which is often complicated by the high cost of the land.

Different Types of Pavement

Engineers use a variety of pavements in modern roads and streets. Their choice of materials is based on such considerations as the volume of traffic expected, climatic conditions, and cost. Cost is the most important, because of the vast mileage of roads and streets still needing improvement. By using the least expensive pavement which will be satisfactory, more mileage can be obtained from any appropriation.

Concrete apparently was first used for paving in Scotland about 1865. American road builders have used it since 1900. For heavy-duty pavement it is divided into slabs from 30 to 50 feet long. The slabs are separated by spaces, or "joints," filled with bituminous material; the joints permit expansion and contraction as the temperature changes. A mesh of steel rods imbedded in the concrete, and dowels, or short steel rods, placed across the joints, hold the pavement together if it should crack.

Macadam is a term for pavement made of broken stone, small enough to pass through a screen with meshes 2½ inches square. This stone is mixed with finer stones and gravel, and packed by a steam roller into a bed from 6 to 12 inches thick. The success of MacAdam's road laid in London in 1817 made this pavement extremely popular; but it did not stand up under automobile traffic because the tires sucked the fine dust from between the larger stones. This difficulty is overcome today by using a bituminous material as a binder; such pavement is called *bituminous macadam*.

Asphalt was first used in the United States in 1867 to pave Pennsylvania Avenue in Washington, D. C. Its use increased rapidly. Asphalt may be laid over rolled sand or gravel, but

ROADS THAT WERE FAMOUS IN AMERICAN HISTORY

Eastern and Middle Western

Albany-New York Highway, or Albany Post Road. Road along the east bank of the Hudson River between New York City, Kingsbridge on Spuyten Duyvil Creek, and Albany; blazed in 1667.

Boston Post Road. A road from New York City via Kingsbridge and Williamsbridge to Eastchester, New Rochelle, and New Haven, Conn. Thence the Upper, or Western, Road ran through Wallingford, Durham, and Middletown; along the Connecticut River (west bank) to Hartford and Springfield, Mass.; and by the Indian Trail through Worcester, Sudbury, and Waltham to Boston. The first postrider took this route in 1673. The Middle Road diverged at Hartford, to Dedham, Mass., and Boston. The Lower, or Shore, Road ran from New Haven through Saybrook and New London to Narragansett Bay. From there one branch ran west of the bay to Providence; the other used ferries to Jamestown and Newport, R. I., and followed the east shore of the bay to Providence. From Providence the Pequot Trail was followed via Attleboro, Mass., Wrentham, and Dedham to Boston.

After 1700 the local authorities did some clearing and built some bridges on these routes.

Cumberland Road, or National Pike. A leading factor in settling the Middle West. Ran from Maryland to Ohio, Indiana, and Illinois.

The route was partially surveyed by George Washington; Albert Gallatin urged construction, and the act which made Ohio a state in 1802 set aside one-twentieth of public-land-sale revenue for the road. Congress authorized construction in 1806, starting at Cumberland, Md., the end of the Chesapeake and Ohio canal. The road ran via Uniontown and Washington, Pa.; reached Wheeling in 1816; Columbus, Ohio, via Zanesville, in 1833; and reached Vandalia, Ill., via Richmond, Indianapolis, and Terre Haute, Ind., in 1852. The road never reached St. Louis, the intended terminal, because public interest shifted to railroads.

Except at the west end beyond Indianapolis, the road had stone bridges and macadam pavement 30 feet wide. National expenditure on it was about $6,759,000.

King's Highway, or King's Way. A road between New York and Philadelphia, along a track first used in 1677, via Newark, Elizabeth, New Brunswick, and Trenton, N. J., and Bristol, Pa. The first through stage ran in 1756; the first bridge was built from Morrisville, Pa., to Trenton, N. J., in 1806. When high water made ferrying difficult over the Delaware at Trenton and over the Raritan at New Brunswick, many travelers took a route between Camden, Perth Amboy, and New York.

Lancaster Turnpike. An important road, 62½ miles long, from Philadelphia to Lancaster, Pa.; beginning of the Pennsylvania route via the Susquehanna, Juniata, and Conemaugh rivers to Pittsburgh. Built by a company incorporated in 1792, along an old Indian trail, which had been called the Great Conestoga Road since 1714. In its final development it had stone bridges and macadam pavement 24 feet wide.

Little River Turnpike. The first American turnpike; established by Virginia in 1785 on existing roads to run from Alexandria to Snicker's or Snigger's Gap (Bluemount) in the Blue Ridge Mountains.

Michigan Road. The first good route between the Ohio River and Lake Michigan; it ran from St. Joseph, Mich., through South Bend, Logansport, Indianapolis, and Columbus, to Madison, Ind. Land for it was ceded by the Potawatomi Indians in 1826; money from sale of land along the route was given Indiana for construction.

Natchez Trace. A route linking Natchez and the Middle Tennessee country, of great importance in the late 18th and the early 19th centuries. Beginning as a series of Indian trails, it was developed as a post and military road after the signing of treaties with the Chickashaw and Choctaw Indians in 1801. In 1806 Congress appropriated $6,000 to improve and shorten it. Frontiersmen returning home after floating their produce down to New Orleans used it extensively. Never more than a wilderness wagon road, it lost its importance with the coming of the steamboat.

Wilderness Road (first called **"Boone's Trace"**). A trail, later a road, from the Watauga settlements in northeastern Tennessee and North Carolina to Kentucky. The route crossed the Holston, Clinch, and Powell rivers, traversed the Cumberland Gap, and followed the Indian "Warrior's Path" to the present Manchester, Ky.; then followed a buffalo trace to the Kentucky River near Boonesborough. An extension ran to Lexington, with branches to Louisville and to Harrodsburg. The route was blazed by Daniel Boone in 1775. In 1795 and later, the Kentucky legislature provided for a wagon road, ferries, and other improvements.

Western

California Trail. A route which varied according to available water supply. One of the most used tracks was from Salt Lake along the Humboldt River to the present Reno, Nev.; then from Truckee, Calif., across the Sierras and along the Sacramento River to the coast.

El Camino Real ("The King's Road"). A track which developed informally to connect missions and settlements in California. It passed through the sites of San Diego, San Juan Capistrano, Santa Ana, Whittier, Los Angeles, Universal City, Oxnard, Santa Barbara, Los Alamos, San Luis Obispo, Paso Robles, Soledad, San Carlos (Carmel), Monterey, and San José. The main trace ended in San Francisco.

Overland Trail. A route first traversed by the fur trader W. H. Ashley in 1824–25, and popularized when the Overland stages began to use it in 1862, because of Indian troubles along the Oregon Trail. It followed the South Platte, and that river's North Fork through the present Fort Collins, Colo., to Laramie, Wyo.; then it crossed southern Wyoming to the Green River. Travelers then turned up the Green to the Oregon Trail, or went west by the site of Fort Bridger to the California Trail, which they picked up near Great Salt Lake.

The **Oregon Trail** and the **Santa Fe Trail** are described in the article Far West.

a concrete base is preferable. The asphalt top gives a smooth-riding street, deadens glare, and reduces noise.

Wood blocks, sawed from logs, were widely used in the 19th century because they were cheap; but they split or rotted quickly. Today, rectangular wood blocks, soaked in creosote or other preservative, are used on a concrete base to deaden traffic noise, as are *rubber* blocks. *Iron* blocks are also being tried to resist heavy wear.

Cobblestone, or boulder, pavements were extensively used in the United States and elsewhere during the 19th century. Modern stone pavements are made of *granite block*, sometimes called *Belgian block*, laid on a concrete foundation. When well laid, such pavements are extremely durable.

Brick, laid on concrete or rolled sand or gravel, gives similar results, if kept in good repair. Use of brick seems to have begun in the United States in 1870.

"Cotton roads," first tried by South Carolina in 1926, contain a strong cotton webbing imbedded in gravel and a bituminous or oil binder. The web tends to prevent cracking, and so lengthens the life of the pavement.

ROBERTS OF KANDAHAR, EARL (1832–1914). When Frederick Sleigh Roberts embarked from England for India in 1852, he was a short, well-knit youth of 20 who carried himself proudly in his new uniform of a lieutenant of artillery. The officers of his mess immediately nicknamed him "Little Bobs."

Quiet, keen, cool, brave, and a shrewd observer, he had all the qualities of a good soldier. His men liked him and were willing to follow wherever "Little Bobs" led. Born in India while his father, a British general, was stationed there, he readily learned the Hindustani language spoken by his native soldiers. He trained himself to remain in the saddle for 36 hours at a stretch. He never got lost in the roughest country, or fell sick in the worst pestholes of India, and he was proverbially lucky.

An officer so equipped could always find employment in India. Roberts distinguished himself in the Indian Mutiny of 1857–58, in the Abyssinian expedition of 1867, and in the Afghan war of 1878–80, rising steadily in rank. His most brilliant exploit was performed as major-general in command of the column that marched from Kabul to the relief of Kandahar in August 1880. He covered the distance of 313 miles, through a rough and hostile country, in 22 days and gained a complete victory. For 41 years he served in India, and when he finally left the country in 1893 he was commander-in-chief of the army in India.

The Savior of South Africa

When Lord Roberts (he had been created baron) was in his 68th year, he was sent as commander-in-chief to South Africa, where the British army was suffering severe reverses in the Boer War of 1899–1902. "Little Bobs is at the helm at last" was the cry of relief from all England. In a few months he brought order out of chaos. He struck at General Cronjé at Kimberley; captured Bloemfontein, capital of the Orange Free State; made the Boers abandon the siege of Ladysmith; divided and demoralized the forces of the enemy; bluffed his way on scant rations into Pretoria; and so turned defeat into victory.

On his return to England in 1901 he became commander-in-chief of the whole British army, and received the title of "Earl of Kandahar, Pretoria, and Waterford." The remainder of his life he devoted to urging the principle of universal military service. He died of pneumonia, in November 1914, while on a tour of inspection of the British forces in France. His life is interestingly told in his autobiography, 'Forty-One Years in India'.

ROBESPIERRE (*rôbs-pē-yĕr'*), **MAXIMILIEN** (1758–1794). Robespierre, the most conspicuous leader of the French Revolution during its "Reign of Terror," suffered the fate of many reformers. His virtues for a time won public approval, but his fanatic intolerance brought him to a tragic end.

As a student in Paris and as a lawyer in his native city of Arras, Robespierre was noted for his ability and perseverance. His kindness of heart was shown when he resigned as judge rather than pronounce sentence of death, and later by his attempt to abolish the death penalty. In the Estates-General of 1789 he won popularity by the sincerity and earnestness with which he fought for his revolutionary ideals.

In the Jacobin Club (*see* Jacobins) Robespierre found his greatest opportunity. He became the acknowledged chief of that powerful body, and also a leader of the people of Paris. His reputation for honesty and incorruptibility added to his power. In the "Convention," the third of the French Revolutionary assemblies, Robespierre was leader of the radical party called "the Mountain." He took a decisive part in bringing the king to trial, declaring that Louis XVI "must die that the country may live."

Robespierre was also the best-known member of the Committee of Public Safety (1793–94), which, during the Terror, saved France from conquest by foreign enemies and from internal revolts. But he was not a man of action; he rarely attended the sessions of the Committee, and had almost no part in its routine work. The credit for France's titanic efforts, as well as the blame for the pitiless guillotinings of that time, belongs to men who are not so well known.

In his personal life and in his principles Robespierre was fanatically austere. He was passionately devoted to the effort to establish the principles of Rousseau (*see* Rousseau, Jean-Jacques). As a deist (a believer in God, though not in Christian revelation), he sent to the guillotine Hébert, who had closed the churches and set up a grotesque worship of "the goddess Reason." Danton, to whose superb energy and audacity the triumphs of the Revolution were largely due, was guillotined because he believed that the Terror had accomplished its work and that the time for moderation was at hand (*see* Danton). Then, to check atheism, Robespierre introduced the "Reign of Virtue" and the worship of "the Supreme Being."

Robespierre's Intolerance Brings His Downfall

Most of Robespierre's associates on the Committee of Public Safety, however, had little respect for him and little sympathy with his ideas. It was said of him that he had "made Virtue odious by continually prating about it." Many feared that they might be sacrificed, like Danton, to Robespierre's love of power and narrow self-righteousness. On July 27 (the 9th Thermidor in the Revolutionary Calendar), 1794, his enemies forestalled an attempt against themselves by obtaining the arrest of Robespierre, Saint-Just, and others of his intimates. In the confusion which followed an attempted rescue, Robespierre was shot in the jaw. The next day he and 19 of his adherents were guillotined. Danton's words, "Robespierre will follow me; I drag down Robespierre," thus proved true. With his fall, the Terror soon came to an end. (*See also* French Revolution.)

ROBIN. In northern United States and Canada, the robin is the herald of spring. His long-awaited warble at dawn seems to say "cheerily, cheer up, cheerily, cheerily," for winter is over. He has the utmost confidence in the friendliness of man, and carries on all

his busy affairs within arm's reach of human neighbors. After his sunrise concert he sets briskly to work searching the lawn for worms, his red breast a gay contrast to the new green of the grass. Erect and still he stands, his black head cocked to one side. Then suddenly he darts at the ground, tugs violently, and triumphantly pulls out a worm. He eats quantities of insects as well, but more than half his diet consists of fruits and berries.

Robins dislike deep woods. They build their nests on the horizontal branches of garden and lawn trees, in porch vines, and in eaves. The nest is a thick bowl of mud, which the mother bird shapes with her breast by turning around and around. It is reinforced with coarse grass, leaves, and roots, and lined with fine grass. A robin lays from four to six eggs of greenish blue, or robin's-egg blue, and raises two or three families a season. The parents defend their young with great courage and will unhesitatingly attack a marauding cat or snake. The old males and young birds assemble at night in roosts, while the mothers remain on the nests with the latest broods. Early in September, after the nesting season is over, they gather in flocks and roam about in search of food until the signal is given to start off for the south. A few hardy individuals winter in the north, taking refuge against storm and cold in deep evergreens and wooded swamps. The southern states know robins chiefly as winter residents. Here their cheery song is seldom heard, and the damage they do to fruits and berries is so great that some farmers obtain licenses to shoot them. They were once shot for the table, but are now protected by Federal law. The robin is the state bird of Michigan, Wisconsin, and Virginia.

A PROUD MOTHER ROBIN WITH HER YOUNG

Two young robins open wide their mouths, hoping for more food, while the mother bird rests for a moment from the endless task of finding worms to feed them. This is an unusually fine photograph of a female robin and her nest.

Robins are about 10 inches long; heads round and black, upper parts dark gray, breasts rusty red, bills yellow, tails tipped with white at the outer corners; females, and males in the fall and winter, are paler; the nestlings have the black-spotted breasts of the thrush family, to which robins belong. The common eastern robin (*Turdus migratorius migratorius*) has the largest range, breeding as far north as the timber line of Labrador and Alaska. The southern robin (*Turdus migratorius achrusterus*), found in the southeastern states, is smaller and paler. The western robin (*Turdus migratorius propinquus*), breeding from British Columbia to Mexico and from the Pacific to the Great Plains, lacks the white tail feathers. (For illustration in color, *see* Birds.)

The English robin redbreast (*Erythaca rubecula*) is an entirely different bird, belonging to the family of warblers. It is about half as large as the American bird, and its breast is a brighter orange-red. Most of the familiar poems and legends about the robin refer to the European bird. Like its American namesake, it seeks human companionship, and is one of the most beloved of birds.

ROBIN HOOD. One of the most romantic of all legendary heroes is the bold outlaw Robin Hood of England. In the days of the Plantagenet kings, the old ballads tell us, Robin Hood with his merry men roamed the green glades of Sherwood Forest near Nottingham in the center of England. There they lived a mirthful life, passing the time in games of archery or bouts of cudgel play, hunting the king's deer, and levying toll on proud churchmen and cruel nobles.

No archer ever lived who could "speed a gray goose shaft" from the longbow with greater skill than Robin Hood. And his heart was as true as his aim was sure. He was a robber, to be sure, but he robbed only the rich, and he shared his spoils with the poor and needy. He was fair in war and courteous to his foes. He shed no blood if he could help it, and he never let harm befall women and children.

How did Robin Hood become an outlaw? According to one tale, he had killed one of the king's deer on a wager and then had slain one of the king's foresters who threatened his life. A price was therefore set upon Robin Hood's head, and he was forced to flee into the depths of the greenwood.

Robin's Band of Merry Men and Their Exploits

Soon there gathered about him other bold men who had been outlawed or deprived of their inheritance, or who hated the hard rule of the barons, or who loved the free life of outdoors better than the settled life of industry. It happened more than once that a man won an honored place in the band by defeating Robin Hood himself in a fair fight. One day, when Robin was about to cross a narrow bridge, a stranger seven feet tall disputed the way. In the bout with quarterstaffs (long, stout sticks) that followed, Robin Hood was worsted and fell into the stream. As soon as he could scramble out of the water and catch his breath, Robin Hood acknowledged the prowess of his adversary and asked him to be one of his men. Thus Little John, so called because of his great size, became Robin Hood's right-hand man. Will Scarlet and Arthur-a-Bland, the tanner, also fought their way into the band and into the leader's affections. Others among the merry men whose names often occur in the ballads were Will Stutely, Much, or Midge, the Miller's son, and the romantic minstrel Alan-a-Dale. Robin Hood's chaplain and confessor was the fat and jovial Friar Tuck.

In the later ballads we hear of Robin's sweetheart Maid Marian. When Robin Hood was outlawed, she dressed as a page and went to seek him in Sherwood

Forest. At last they met; but since both were disguised, neither recognized the other. They fought until Robin, admiring the valor of his foe, invited Marian to become one of his band. Then she recognized his voice.

Robin Hood's greatest enemy was the Sheriff of Nottingham, who sought by force and by guile to bring the outlaw to justice, but was always outwitted. The sheriff even proclaimed a shooting match, feeling sure that Robin Hood would appear to show his skill as an archer. The wily outlaw did appear, but in disguise. He won the prize, a golden arrow, which was handed to him by the sheriff himself. Not until Robin Hood was once more safe in Sherwood Forest did the sheriff learn how he had been tricked.

Although Robin Hood lived on the king's deer, the outlaw "loved no man in the world so much as his king" and would gladly have died for him. According to one tale, King Richard the Lion-Hearted once went in disguise to Sherwood Forest and having tested Robin Hood's loyalty granted him a royal pardon.

FRIAR TUCK OUTWITS ROBIN HOOD

The stout and merry Friar of Fountain Abbey has dropped Robin Hood into the water after being tricked into carrying the outlaw across a stream. Here he stands, laughing at his victim's wrath. As an outcome of this adventure, Friar Tuck joined Robin's band.

A Real Person or a Mythical Character?

Was Robin Hood a real person? It is possible that there is some historical basis for the legends; that they grew up about some actual victim of the ruthless forest laws of old England. Robin Hood is said to have lived from 1160 till 1247. Some stories represent him as a yeoman, others have it that he was of noble birth. According to some accounts, he was created Earl of Huntingdon by Richard the Lion-Hearted. Most of the legends say that Robin Hood died at Kirklees Priory, in Yorkshire, and near the ruins of this priory is a grave supposed to be Robin's. The epitaph (with the spelling modernized) reads:

Here underneath this little stone
Lies Robert, Earl of Huntingdon.
Ne'er archer was as he so good
And people called him Robin Hood.
Such outlaws as he and his men
Will England never see again.

Below is a statement that Robin died in 1247. Some believe that the inscription, which is in 18th-century lettering, is a copy from an earlier and genuine stone, but most scholars doubt this. An argument against the existence of the hero is the fact that he is mentioned by no historian of the time during which he is supposed to have lived. Even if there is some basis of truth in the legends, the details could not all be possible, and the events referred to in the stories could not all have taken place during his lifetime.

More probably, Robin Hood was a mythical character that was first introduced into England in connection with the plays and pageants and morris dances of the May-day celebrations. The earliest record of a "Robin" connected with such festivities is in the rustic plays given at Whitsuntide in France in the 13th century. The hero was called *Robin des Bois* (Robin of the woods). The fact that an old English spelling of *wood* was *whode*, which could easily have become *hode*, might account for the name Robin Hood. At any rate, in the 15th century and later, the May-day celebrations in England were called "Robin Hood's Festivals." Garlands of flowers, a Maypole, morris dances, archery contests, and bonfires were features. Robin Hood was King of May, and Maid Marian was his queen.

Robin Hood's Place in Legend and Literature

Whether Robin Hood was a semi-historical character or only a mythical figure, he represents the ideal of the common people in England in the later Middle Ages, as King Arthur represents the ideal of the upper classes. He stands for liberty and the rights of the people against oppressive laws and the tyranny of the nobles. Many countries have their outlaw heroes, more or less legendary, who defy unjust authority and perform miracles of prowess against the oppressors. Robin Hood thus holds a place with the legendary William Tell of Switzerland, and with Rob Roy of Scotland and Wat Tyler and John Ball, who led the Peasants' Revolt in England in 1381.

The most ancient ballads of Robin Hood have been lost, but between 30 and 40 have been preserved, some of them dating as far back as the 14th century. In addition to these, a connected life of the hero in verse, entitled the 'Little Gest of Robin Hood' (*gest* means a tale of deeds), was compiled from a number of the older ballads and printed about 1500. The best modern version of the legends is Howard Pyle's 'Merry

Adventures of Robin Hood'. From about the end of the 16th century Robin Hood became a popular subject for dramas and operas. Tennyson's drama 'The Foresters' is based on legends of the outlaw, as is also Reginald de Koven's light opera, 'Robin Hood'. Sir Walter Scott introduced Robin Hood into two of his novels—'Ivanhoe' and 'The Talisman'.

ROBINSON, EDWIN ARLINGTON (1869–1935). Although many critics honored him during his lifetime as "the greatest living American poet," Edwin Arlington Robinson was not widely known among his countrymen. This was due partly to the fact that his poetry is too subtle and closely packed with thought to be read easily, and partly to the retiring character of the poet himself.

Robinson was born in the little village of Head Tide, Me., but passed his boyhood in Gardiner, the "Tilbury town" of many of his poems. He entered Harvard in 1891, but had to leave after two years because of his father's illness. He had already published two small volumes of verse, when in 1900 he went to live in New York City. He continued to write poetry while he supported himself by various kinds of work, including that of subway inspector. Through President Theodore Roosevelt, who became interested in his poetry, he got a position in the New York customs house which he held for several years. The rest of his life was devoted entirely to writing. For many years he spent his summers at the MacDowell Colony in Peterboro, N. H., where much of his finest poetry was written. Gradually recognition came to him. He was awarded the gold medal of the American Institute of Arts and Letters in 1929, and three times received the Pulitzer prize.

As a "biographer of souls" Robinson was equally successful in his sketches of New England characters, such as 'Miniver Cheevy'; in presenting men and women of today in the grip of tragic forces, as in 'Cavender's House'; and in portraying the romantic figures of Arthurian legend, as in 'Tristram'. Although he took a fatalistic and somber view of life, he had a kindly humor, with unbounded tolerance and sympathy for those who seemed to have failed. A reviewer once said that to the poet "the world is a prison house." Robinson replied: "The world is not a 'prison house', but a kind of spiritual kindergarten where millions of bewildered infants are trying to spell 'God' with the wrong blocks."

His compressed style enabled Robinson to present a whole life history in a few lines. Many of his poems are long, but he never wastes a word. His verse is sometimes austere to the point of bareness, sometimes rich in music and sensuous beauty. Occasionally it rises to heights of emotional intensity that have scarcely been surpassed. He followed traditional verse forms, but used them in an individual way.

Robinson's poetic works are: 'The Torrent and the Night Before' (1896); 'The Children of the Night' (1897); 'Captain Craig' (1902); 'The Town Down the River' (1910); 'The Man Against the Sky' (1916); 'Merlin' (1917); 'Lancelot' (1920); 'The Three Taverns' (1920); 'Avon's Harvest' (1921); 'Roman Bartholow' (1923); 'The Man Who Died Twice' (1924); 'Dionysus in Doubt' (1925); 'Tristram' (1927); 'Sonnets' (1928); 'Cavender's House' (1929); 'The Glory of the Nightingales' (1930); 'Matthias at the Door' (1931); 'Nicodemus' (1932); 'Talifer' (1933).

ROB ROY (1671–1734). Everyone who has read Sir Walter Scott's novel 'Rob Roy' knows something of the exploits of this celebrated Scottish outlaw. His real name was Robert MacGregor. Because of his red hair people called him "Roy," which is the Gaelic word for red. He was also known by the surname Campbell, his mother's maiden name, which he took because the MacGregor clan had been outlawed by the Scottish Parliament.

When Rob Roy was 22, he became head of the MacGregor clan and inherited large estates. Like other land owners of the Highlands, he engaged in raising cattle for the English market. To protect his herds he kept about him a band of armed followers. He himself was famous as a skilled broad-swordsman. He borrowed money from his neighbor the Duke of Montrose for his cattle business, and because of unfortunate speculations was unable to repay it. The Duke seized his lands and had him declared an outlaw, whereupon Rob Roy, in desperation, collected a band of his clansmen and made war on the Duke, stealing his cattle and his rents as well. Many stories are told of Rob Roy's narrow escapes from the troops that were sent to capture him. In 1722 he gave himself up to the English authorities. After being imprisoned for a time he was pardoned and permitted to return to his home in the Highlands, where he died in 1734.

ROCHAMBEAU (*rō-shäṅ-bō'*), JEAN BAPTISTE DONATIEN DE VIMEUR, COUNT DE (1725–1807). For 33 years before he was sent to America to aid the American colonists in their struggle for independence, Count Rochambeau had served with distinction in the French army. When the treaty of alliance between the French king and the American colonies was signed in 1778, Rochambeau was made lieutenant-general and sent with 6,000 men to the aid of Washington. He rendered valuable services in the final campaign that ended with the surrender of Cornwallis at Yorktown.

When the revolutionary movement in his own country began in 1789, Rochambeau for a time took part on the side of the Revolution. But he soon became disgusted with the excesses of the leaders and resigned his command. During the Reign of Terror he was imprisoned and narrowly escaped the guillotine; but Napoleon restored to him his estates and rank. In 1902 the Republic of France presented to the United States a statue of Rochambeau, which now stands in Lafayette Square in Washington, D. C.

ROCHESTER, N. Y. This large industrial center and lake port, the third city in size in New York State, owes its position primarily to water power and water transportation. It is situated on the beautiful Genesee River seven miles above Lake Ontario, and on the New York State Barge Canal. Within the city limits the river falls 261 feet in three cataracts, a fact which led Ebenezer Allan to build a sawmill

and gristmill on the site in 1789. Today the falls furnish an enormous amount of hydroelectric power for the city's varied industries. At the mouth of the river is the port of Rochester, which accommodates large quantities of incoming and outgoing freight as well as a busy passenger traffic.

Rochester manufactures a number of small products that require highly skilled artisanship. The Eastman Kodak Company is the largest camera-manufacturing and photograph supply concern in the world. It produces a large percentage of the country's motion picture film. Optical glass, machine tools, check protectors, filing devices and office systems, thermometers, telephone apparatus, ivory buttons, enameled steel tanks, women's shoes, and men's clothing are other important manufactures. The city also has large nurseries and seed establishments. The rich truck-farming and fruit-growing country that surrounds it supplies materials for a food-canning industry and for the production of soda-fountain fruits and syrups. In 1934 Rochester celebrated the one-hundredth anniversary of its incorporation as a city.

Rochester is a most attractive city, within easy motoring distance of the Finger Lake resort region. It has an extensive park system; the largest parks are the Genesee Valley and the Durand-Eastman. The bed of the old Erie Canal has been made into a subway for freight and passenger traffic. A belt line running through it connects with all the railroads entering the city. The University of Rochester, founded in 1850, was rebuilt in 1925 on a new site. It includes the Eastman School of Music, with the beautiful Eastman Theatre, seating 3,300 people. Other educational institutions are the Colgate-Rochester Divinity School and the Rochester Athenaeum and Mechanics Institute. Population (1940 census), 324,975.

ROCK. Various and complicated as rocks seem at first sight, the facts about them of greatest importance to geology are easy to grasp with the aid of a few clues. For example, 99 per cent of the earth's crust is made up of only eight chemical elements. Oddly enough, the first in rank is a gas—oxygen—which has formed compounds with the other seven elements. The oxygen alone in these compounds accounts for nearly half of the crust's weight. Silicon accounts for more than one-fourth; aluminum, about one-thirteenth; iron and calcium together, about one-twelfth; and sodium, potassium, and magnesium for the rest of the 99 per cent (*see* Earth).

Igneous Rocks—the First to be Formed

The most abundant rocks are the *igneous* or "fire-made" kind, formed long ago by heat and pressure in the interior of the earth and later thrust up to the surface. In the terrific heat the elements named above were fused, and, as they cooled, they combined with one another in various ways to form *minerals*—that is, substances having a definite chemical and physical structure (*see* Minerals). In the upheaval and final cooling, the minerals solidified into rocks, which are usually mixtures of more than one mineral.

We identify rocks by the minerals they contain. *Quartz*, a simple compound of silicon and oxygen, is one of the commonest of these minerals (*see* Quartz). Others are the *feldspars*, composed of silicon, oxygen, and aluminum, plus one or more of the potassium-sodium-calcium groups (*see* Feldspar). The *micas* are similar to the feldspars in chemical ingredients, but with a different arrangement and crystal structure (*see* Mica). Mixtures of these three minerals—quartz, feldspar, and mica—make up the rocks called *granites* (*see* Granite). Rocks that cooled slowly at great depths are generally coarse-grained; those that cooled rapidly near the surface are fine-grained. If the magma, or molten rock, moved upward while cooling, it may be porphyritic—that is, it may contain large grains imbedded in a finer-grained mass. (*See* Lava.)

Life History of Sedimentary Rocks

From the moment rocks are uplifted above the sea, they are attacked by wind, water, and other forces. The crushed or powdered products so formed tend to be carried by water to the sea and deposited on the sea bottom. Typically, the coarse gravels fall nearest the shore; then sand is deposited; farther out materials carried as "mud" drop down; and finally there is a deposit of ooze, consisting largely of material formed in the sea.

Gradually these products become squeezed by pressure from above into *sedimentary rock*. Gravelly fragments, often cemented together by silica, form *conglomerate rock*. Powdered igneous material, principally quartz ground into sand, becomes compressed into *sandstone*. Many silicates of aluminum and silicon are transformed into a soft material, perhaps partly colloidal in nature (*see* Colloids), which enters into beds of *clay*. Clays become compressed into *shale*.

All such rocks are called *clastic* (from the Greek for "broken"), because they are formed directly from fragments of pre-existing rock. An important *non-clastic* group of rocks is the limestones. These are formed principally of shells and other remains of animals and plants, into which calcium carbonate entered as a stiffening material.

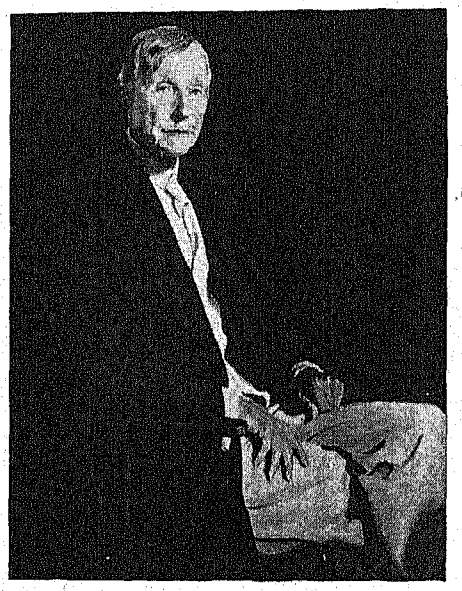
Metamorphic Rocks

The third principal class is the *metamorphic* rocks. These are igneous or sedimentary rocks which have been changed by heat, pressure, or chemical action. *Marble*, for example, is metamorphosed and crystallized limestone. *Gneiss* is a metamorphosed granite which has somewhat of a layer structure; when the layers are well developed, the rock is called *schist*. Shale by compression into layers becomes *slate*. *Quartzite* is sand cemented by silica.

Thus, by following the chemistry and formation processes involved, we see that the whole great array of rocks is related in simple fashion. The study of rocks is called *petrology* (from the Greek *petros*, a rock). How the rocks are shaped into mountains and other forms is the story told by geology. (*See* Geology; Physiography; and articles on the principal rocks by name.)

ROCKEFELLER, JOHN DAVISON (1839–1937). The fame of John D. Rockefeller depends equally upon his genius as a great business organizer and his generosity in giving away a half billion dollars of the huge fortune he had created.

Rockefeller was born in Richford, N. Y., his family moving to Cleveland, Ohio, when he was 13. He received a common school education, worked as bookkeeper when he was only 16, and was a partner in a produce commission firm, Clark and Rockefeller, at 19. In 1862 he and Clark invested in an oil refinery with improved refining processes worked out by Samuel Andrews. In 1865 he sold out to Clark, bought a share in another refinery, and organized the partnership of Rockefeller and Andrews. This firm in 1867 merged with that of Rockefeller's brother, William. In 1870 the Standard Oil Company was formed, including the two Rockefellers, Andrews, Henry M. Flagler, and Stephen V. Harkness. Beginning with a capital of $1,000,000, this company in about ten years controlled 95 per cent of the oil refining business in the United States.



JOHN D. ROCKEFELLER
The Croesus of the Modern World

The methods by which the oil monopoly was achieved have often been severely criticized. In the 1870's the railroads were desperately competing for business, and the practise of offering rebates, that is, secretly refunding a part of the money paid by a shipper, was common. The Standard Oil Company, like many other firms at that time, took these rebates as a means of "freezing out" competition. These methods, while by no means confined to Standard Oil, were justly criticized, and the rebate system is today strictly forbidden by law. But strangely enough, Rockefeller was criticized with equal harshness for developing the corporate form of business, now world-wide, which is indeed a tremendous step ahead in business organization. It represents Rockefeller's greatest contribution to a world struggling to master the technique of large scale production and distribution. Nevertheless, largely because of public resentment against the rebate practise, the Standard Oil Company was twice dissolved (in 1892 and again in 1911) into its constituent companies.

Other factors which contributed to the success of Standard Oil and to modern methods of business were the system of pipelines bringing crude oil from the producing fields to the refineries, and the economies effected by the staff of scientific experts.

Rockefeller himself, when he retired from the management of the company in 1911, had no exact idea of the size of his fortune, but it is generally believed to have been more than a billion dollars, making him the richest man in the world. Of this immense fortune Rockefeller distributed about $500,000,000 in well-considered gifts.

He founded, and gave many millions to the University of Chicago; he promoted many branches of welfare work through the Rockefeller Institute for Medical Research, the Rockefeller Foundation, the General Education Board, and the Laura Spelman Rockefeller Memorial. He distributed more than $22,000,000 in war relief during 1914–19. Among the projects aided by the Foundation are the China Medical Board, the International Health Board, the Commission for the Prevention of Tuberculosis in France, the Peking Union Medical College, and the schools of hygiene at Johns Hopkins University and at the University of São Paulo, Brazil. The graduate school of education at Harvard, and Teachers' College at Columbia University have received large sums.

Rarely did Rockefeller place any restrictions on the manner in which his great gifts were to be administered. He specified merely the broad purpose for which they were to be used, making them adaptable to the changing needs of the future. At his death his personal fortune had decreased to about $25,000,000.

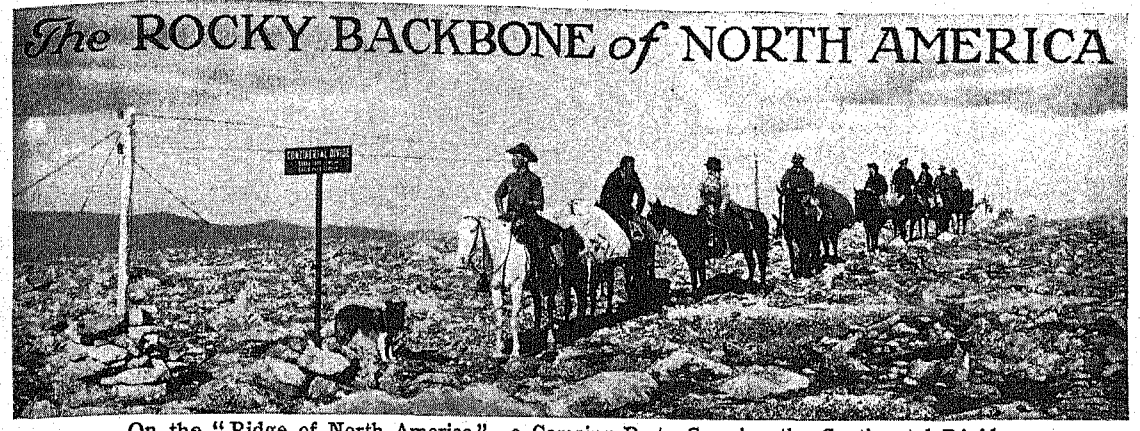
Rockefeller was a Baptist and was greatly interested in church work. He died May 23, 1937, at his home in Florida. He failed by only two years to realize his ambition of living to be a hundred.

JOHN D. ROCKEFELLER, JR., was born in 1874, in Cleveland, Ohio, and attended Brown University, receiving his A.B. degree in 1897. He entered his father's business and learned the workings of the vast organization, but after a few years he withdrew to devote his attention to the complicated business of distributing the Rockefeller benefactions.

He has likewise given generously of his own wealth some $50,000,000, having made gifts to the Northern Baptist Convention, the Bureau of Social Hygiene, Brown University, the Church World Movement, International House, the New York Public Library, the Cathedral of St. John the Divine, the Young Men's Christian Association International Committee, Hampton Tuskegee Institute, Metropolitan Museum of Art, and to the restoration of the Versailles palace and Reims Cathedral.

ROCKY MOUNTAIN GOAT. "He can climb like a Rocky Mountain goat!" This has always been the highest praise that could be offered to a mountain-climber. The sturdy, sure-footed creature, whose flesh has a musky taste, is really an antelope, and not a goat. Small herds still scramble in the high spots of the Rockies. (*See* Antelope.)

The ROCKY BACKBONE of NORTH AMERICA



On the "Ridge of North America"—a Camping Party Crossing the Continental Divide

ROCKY MOUNTAINS. This long multiple chain of rocky and snow-capped mountains that runs through North America, from the border of Mexico to Alaska, is sometimes spoken of as the backbone or the roof of the continent. In Colorado alone the mountain area is three times that of the Alps, and it includes more than 300 peaks that rise far above the timber line. There are no less than six national parks in the Rockies, not counting other reservations. The name Cordilleran system is now generally given to the whole series of highlands stretching through western America from Panama to the westernmost of the Aleutian Islands, and extending from the Great Plains on the east to the Pacific Ocean on the west; and of these highlands the Rocky Mountains are the eastern half.

The scenery in the Rockies varies from the strange formations of the Yellowstone region, in northwestern Wyoming, to the Alpine landscapes of Glacier National Park in Montana and the flat-topped mesas of New Mexico. In the northern Rockies are numerous small glaciers, though there are few elsewhere in the system. In Colorado, the typical Rocky Mountain state, the mountains occur in several parallel north and south ranges, with broad grassy parks or valleys in between. These smooth valley floors, lying at altitudes of from 6,000 to 7,000 feet, slope gently to the base of the mountains. Colorado contains some of the sources of every great western river except the Columbia, which rises in British Columbia.

In climbing one of the Rockies—Pikes Peak, for instance, which rises 14,110 feet from the plain—you find the greater part of your way lying through forests. At 11,000 feet or 12,000 feet the trees finally give way to sturdy healthy growths, but not without a struggle. On the frontier line the trees stand only eight or twelve feet high, deformed by the buffeting of the wind, their straggling branches all pointing leeward. Sometimes they crawl along the ground instead of standing at all.

But the summits are not so bare as they look from a distance above the dark cloak of forest. Even in the regions of snow and glaciers the simpler forms of plant and animal life are found, and wherever soil can cling to the gentler slopes, you will find Alpine pastures, rolling moorlands, and wet meadows like the Arctic tundra. Sometimes there are acres of low tangled growth—wintergreen, huckleberry, Arctic willow, and black birch; sometimes carpets of columbine and paintbrush, crimson purple primroses, spring beauties, daisies, buttercups, forget-me-nots, or purple asters and goldenrod, according to the season. Now and then you come upon a little blue lake lying in a cup hollowed out by some glacier millions of years ago. There are a thousand or more of these exquisite lakes in Colorado alone.

Among the sheer walls and shattered summits breaking off into canyons, at heights of 12,000 feet and more, you may catch sight of the mountain sheep. Following their leader they make long flying leaps from one slender shelf of rock to another, rarely coming to the lower levels except to visit some salt lick. In the winter they huddle together against the side of a ledge and let the snow blow over them as it will. Below them the slides thunder down, trailing a spray of snow. Other animals of the Rockies are the mountain lion, the sheep's greatest enemy, and the black and grizzly bears.

It is only in our own day that the Rockies have become a playground for the nation. In 1803, when the Rocky Mountains constituted the western boundary of the Louisiana Purchase, no white man had ever looked upon their northern ranges. And before 1840 the smoke of the trapper's campfire, and a few scattered trading posts—far up the headwaters of the Missouri and other rivers, or over the Continental Divide at the headwaters of streams flowing into the Pacific—were almost the only trace of the white man in the Rockies. The trappers would spend their winters laying traps and trading with the Indians, and in the spring would float their furs down with the spring freshets to St. Louis.

Next came the miners, about 1858, some ten years after the discovery of gold in California. Almost all the ranges of the Rocky Mountains are rich in some sort of ore. There is gold and silver in Colorado,

Utah, and the Black Hills of South Dakota, and copper in Montana and New Mexico.

But today the typical industry of the Rocky Mountain states is neither trapping nor mining, but farming. Even in Colorado the annual product of irrigated lands is often more than that of its mines.

Geologically the Rocky Mountains are much younger than the worn-down and re-elevated Appalachians. They were formed by numerous long-continued movements of geologically recent date, consisting of repeated irregular uplifts. In the United States some of the chief ranges are the following: The Bitterroot, Coeur d'Alene, and Mission ranges, and the Salmon River Mountains in the Idaho-Montana region; the Wind River, Teton, and Laramie mountains of Wyoming; the Wasatch Mountains of Utah; the Front Range and "Park" Mountains, Sangre de Cristo Range and Sierra Blanca in Colorado; and the Sacramento Mountains in New Mexico. Important peaks are: in Idaho, Hyndman Peak (12,078 ft.); in Montana, Mount Douglas (11,300 ft.); in Wyoming, Fremont Peak (13,730 ft.), Grand Teton (13,747 ft.); in Utah, Gilbert Peak (13,422 ft.); in Colorado, Mount Elbert (14,431 ft.), Mount Massive (14,418 ft.), Blanca Peak (14,310 ft.), Harvard Peak (14,399 ft.), Longs Peak (14,255 ft.), Mount of the Holy Cross (13,986 ft.), Pikes Peak (14,110 ft.); in New Mexico, North Truchas Peak (13,306 ft.), and Santa Fe Baldy Peak (12,623 ft.).

In Canada the term Rocky Mountains may be considered as covering the whole of the western highlands. There the mountains have a more rugged and Alpine character than in the United States, with numerous glaciers. The chief ranges and peaks are the Saint Elias Range (Mount Logan, 19,850 ft.) in the Yukon, and Mount Fairweather (about 15,300 ft.) in British Columbia.

RODENTS. By far the largest of all the orders of mammals in point of numbers is that of the rodents or gnawing animals. It contains about 2,000 species, distributed in nearly all parts of the world, and embracing such familiar animals as squirrels, hares and rabbits, rats and mice, gophers, porcupines, and beavers. All rodents have broad chisel-like incisor teeth adapted for gnawing. There are no canine teeth, and so a gap occurs between the incisors and the molars, or grinding teeth. The incisors keep constantly growing from the roots as fast as they are worn away from the top, and the lower jaw is so hinged as to allow not only an up-and-down movement but also backward-and-forward and sidewise motions as well.

Most rodents are small, the largest, the capybara of South America, being only the size of a half-grown pig; but they work mischief far out of proportion to their size, devouring field crops and food stores and some of them carrying dangerous diseases to man and other animals. Their habits of living are remarkably varied, some of them living in trees, some on the ground, some chiefly underground, and some chiefly in the water. Their food is principally vegetable matter. Some of them are valuable for their fur, notably the hare, beaver, the beautiful little squirrel-like chinchilla, and the coypu of South America and the West Indies from which comes the familiar nutria fur.

Despite their small size, the rodents have come to predominate over other groups of mammals because of their immense fecundity, their wariness, and their ability to get a living in places where other animals would perish. All the chief rodents are described in separate articles in these volumes.

RODIN (*rō-dăn'*), FRANÇOIS AUGUSTE (1840–1917). Sketching animals in the Paris parks at six o'clock of a morning; in drawing school from eight until twelve o'clock; eating a pocket lunch to get in a hurried noon visit to the Louvre gallery; clerking in the shop of an ornament maker all the afternoon; and in the evening more drawing, sometimes far into the night. This was the daily program of the boy Rodin, at 14 years of age.

A hard program for a boy, but out of it grew one of the greatest sculptors of all times. Fate generally evens things up, and through the poverty and hardship of his boyhood experience came the independence and courage that fitted Rodin to triumph over the criticism he was to encounter during most of his life. For Rodin did not follow the fashion of the day by creating idealized statues and sculptured groups that were merely graceful and pleasant to look at. Instead, he expressed in bronze and marble the sternness of life as it had come to him, as he had found it portrayed in gaunt lined faces about him.

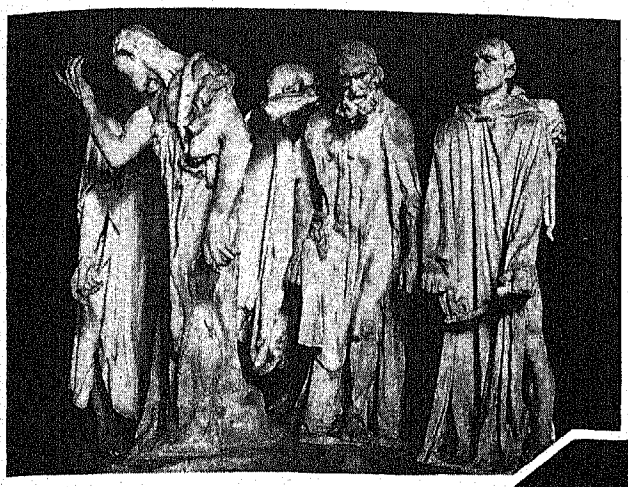
To the storm of criticism from a public that found his work "ugly," this man from his own experience could answer, "Nothing is ugly that has life. Whatever suggests human emotion, whether of grief or pain, goodness or anger, hate or love, has its individual seal of beauty."

The First Great Success

Still poor and unknown, at the age of 37 Rodin succeeded in entering his statue, 'The Age of Bronze', in the salon exhibition of Paris. It was so realistically done that the entrance jury accused the artist of having molded the face in plaster from a living model, instead of modeling it by his art. This unjust accusation, as it turned out, brought Rodin both fame and friends. An artist member of the government heard of the charge and went to watch Rodin at work. He was so impressed at the rapidity and sureness of his modeling that he himself went to the jury of the salon, declaring that 'The Age of Bronze' was only one example of the realistic workmanship of this unknown artist. He convinced the jury, and the much-discussed statue was bought by the state and placed in the Luxembourg Gardens. After this Rodin was no longer unknown. The unjust accusation had brought him before the public in a way that praise would not have done, and had given him friends that were to be his for life.

"NOTHING IS UGLY THAT HAS LIFE"

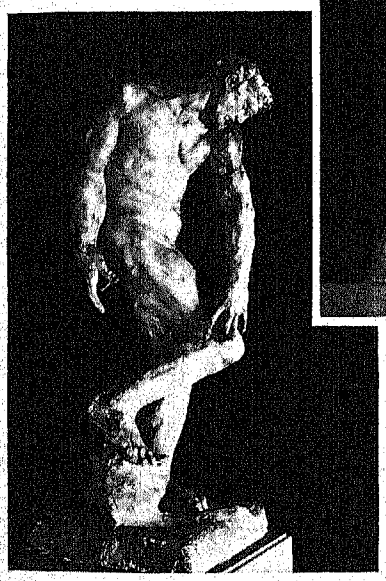
"I Obey Nature in Everything," said Rodin, "and I Never Pretend to Command Her"



'BURGHERS OF CALAIS', the famous group which stands before the Hotel de Ville in Calais, represents the six burghers who gave themselves up as a ransom for the other citizens when Edward III of England conquered Calais in 1347. They expected to die, but were spared. "Their souls push them forward, their feet refuse to go," explained Rodin.

'EVE', the strong figure at the right, is Rodin's idea of the mother of mankind, no delicate and sweetly pretty feminine figure such as the 19th century critics admired. 'Eve' as well as 'Adam' below are details of the artist's great design, 'The Portal of Hell'.

'LE PENSEUR', at left, is often called Rodin's masterpiece. The Thinker was designed to sit at the top of the Portal of Hell group, looking down in brooding despair on the unhappy story of the human race, as told in the Gates. The huge toiler's body of this figure is a symbol of the power of real thought.



'ADAM', above, is another vigorous emotional figure of the kind which distressed Rodin's early critics. They were used to the sleek surfaces and weak structure of other sculpture of the period.

'THOUGHT', at right, is Rodin's idea of the thinking process, not as an easy, airy, mental game, but as a struggle. The peasant girl's head, in her cap, thrusts itself gravely up from the mass of marble, which is intentionally left rough and unhewn. The head strives to free itself from the stone as a thought strives to take shape in the mind.

But until he was 50 years old, Rodin lived and worked in poverty. Almost every creation that came from his studio was received at first with active disapproval, followed by curiosity, half-recognition, and finally enthusiasm. Rodin's was a long and hard probation. "I never knew," he said, "what encouragement meant. The little terra cotta heads and figures I put in the shop windows never sold. Yet at my work I was never sad, I always had pleasure in it."

In addition to works expressing pain and despair, he has given groups that throb with joy and ecstasy. He did many unusual things. One of the most striking was to leave his figures half cut from the marble. In many, such as 'The Broken Lily', 'Thought', and the monument to Victor Hugo, the unfinished figures seem to rise from the block, and yet no line is lacking to leave the impression perfect.

When Rodin was 76 years old he deeded to the French government the entire collection of his own works and other art objects he had acquired. They occupy the Hôtel de Biron, in Paris. This is the only museum in the world where a sculptor's masterpieces are to be seen as placed by their creator. Art lovers from all parts of the world come here to study Rodin's work. Rodin's studio at Meudon, near Paris, is also preserved by the government.

Rodin never acknowledged any work as his masterpiece, but the 'Burghers of Calais' in its intense naturalism and dramatic energy is the culmination of his genius. The monument to Balzac shows the eccentricity of Rodin. Several small groups such as 'The Kiss' and 'Eternal Spring' show the artist in his expression of the beautiful. The statues 'John the Baptist', 'Eve', and 'The Age of Bronze' are familiar wherever art is appreciated. The well-known 'Thinker' is from the unfinished 'Portal of Hell'.

Few important galleries are without examples of Rodin's art. The Metropolitan Museum of New York City has 21 pieces of statuary, besides studies, drawings, and casts. The Rodin Museum in Philadelphia, opened in 1929, was given to the city by Mr. Jules Mastbaum. It contains many originals and bronze casts from the Musée Rodin in Paris.

ROLAND. Among the Basque mountaineers of the Pyrenees the story still runs that on stormy nights among the mountain crags can be heard the ghostly echoes of the horn sounded centuries ago by Roland, the legendary hero of Charlemagne's army, as he lay dying at Roncesvalles (French Roncevaux), after holding in check the vast army of the Saracens.

There have been so many tales told of Roland it would be difficult to choose the most interesting. In the Middle Ages the minstrels sang of him at castle firesides while the winter snows drifted outside, and in battle the defeated troops rallied again to the charge when they heard the glorious deeds of Roland chanted before them. The best known of all these stories were gathered into one great epic poem called the 'Song of Roland'. This has been translated into many languages and sung from sunny Italy to far-away Iceland. Famous poets have written about the hero's adventures.

The legend of Roland is based on authentic history. Charlemagne, who is said to have been the hero's uncle, was fighting the Saracens in Spain in the year 778, when he was recalled by a report of disturbances at home. As he crossed the Pyrenees, the rear guard of his army was cut off and destroyed in a narrow defile by the savage Basques of the mountains. Historians of the time tell how Count Hruodland or Roland of the Breton March was among those killed.

The Glories of the Legend

This massacre was made the basis for the heroic legends of Roland. In the 'Song of Roland' poetic imagination has transformed the Basques into a Saracen army of 400,000 men, whom Roland and his followers held at bay.

The armies clashed with cries and shouts, the whizzing of darts and hissing of arrows, wrote the poet. The battle-cry of the Franks sounded high above the confusion. Roland was ever in the forefront of the battle. His sword, Durendal, cut down the bravest and strongest of the enemy, and his powerful war-horse trampled the turbans of the Moors under its hoofs. His brother-in-arms, Oliver, called to him to summon Charlemagne's aid by sounding his horn, but he refused and the battle went on fiercer than before. But there was no resisting the overwhelming numbers of the enemy. One by one the dauntless knights fell fighting, and soon only a few remained alive. Then Roland, knowing that death was near, raised his horn to his lips and blew a mighty blast.

Now this horn, or oliphant as it was called, had been a gift from the King. Only Roland of all the knights was strong enough to sound it, and so wild and sweet and penetrating was its note that on hearing it birds fell from the trees, the ground shook, chimneys fell from the houses, and people cried out with their fingers in their ears. Only in deadliest peril would Roland sound his horn. But now—

> Roland raised to his lips the oliphant,
> Drew a deep breath, and blew with all his force,
> High are the mountains, and from peak to peak
> The sound re-echoed; thirty leagues away
> 'Twas heard by Carle and all his brave compeers.
> Cried the King: "Our men make Battle!"

The Death of Roland

At once Charlemagne turned back, but it was too late. All of the little army was slain and Roland was dying.

> The Count Roland feels through his limbs the grasp
> Of death, and from his head ev'n to his heart
> A mortal chill descends. Unto a pine
> He hastens, and falls stretched upon the grass.
> Beneath him lies his sword and oliphant,
> And towards the heathen land he turns his head,
> That Carle and all his knightly host may say:
> "The gentle Count a conqueror has died."

So in the sad Pass of the Roncesvalles perished the mighty Roland, the hero of the Franks.

ROLAND (*rō-läṅ'*), **MADAME** (1754–1793). "O Liberty, what crimes are committed in thy name," cried this eminent Frenchwoman, and bowed to the clay statue of Liberty standing near the guillotine. Then placing her head on the block, she paid with her life for her opposition to Robespierre, Danton, and their fellow Terrorists of the French Revolution.

As a child in Paris, Marie Jeanne Philipon—as she was then named—was a great reader, devouring all that came her way, and the reading of Plutarch made her a republican. In 1780 she married Jean Marie Roland, a government official who afterwards became a leader of the Girondist party. When the Revolution came, Madame Roland, with her masculine intellect and woman's heart, became the queen of a coterie of young and eloquent enthusiasts in Paris, who professed moderate republican views and opposed the excesses of the more radical party. The frequenters of her drawing-room included not only all the famous and ill-fated leaders of the Gironde, but at first even Robespierre and Danton, leaders of the Jacobins, were of her circle.

When the Girondists fell, because of their protests against the "September massacres" and their attempt to guide the Revolution in moderate courses, her husband escaped from Paris to safety. Madame Roland was arrested and spent months in prison before death closed her tragedy of life; it was during this time that she wrote her unfinished 'Memoirs'. Her character took on a new refinement through suffering; in Carlyle's phrase, "like a white Grecian statue, serenely complete, she shines in that black wreck of things." On Nov. 8, 1793, she was carried to the guillotine along with a trembling printer, whom she asked the executioner to take first in order that her fellow victim might be saved the horror of seeing her head fall. A week later her husband died by his own hand near Rouen, unwilling to live longer in a world of violence and disorder.

ROMANCE. In the Middle Ages the nobles of Europe lived in lonely castles, usually perched in some inaccessible position; and no less lonely was the life of the people within. There were few books to read and fewer who could read them. Travel was hazardous and rarely undertaken except for a pilgrimage or a crusade.

In such a life one can understand that visitors were eagerly welcomed. Peddlers, jugglers, mountebanks of all sorts, were constantly being entertained. Most welcome of all was the minstrel or singer, who was called a *trouvère* in northern France and a *troubadour* in the south. Lord and lady, children and servants, would gather around the fireplace of the great hall to hear the minstrel chant his thrilling tales of love, of war, and of mighty deeds. Through his array of songs ran the spirit of chivalry, the social ideal of the feudal age. (*See* Feudalism; Knighthood.) Chivalry taught knights to defend the church, to make war against the infidel unceasingly, to be courteous, and to keep their word no matter what difficulties arose.

Around these ideals, and around the stories of history and legend which exemplified them, the minstrel built his lays. They were called "romances" because the minstrels used one of the "Romance" languages—that is, languages derived from the old Roman or Latin tongue. (*See* Romance Languages.)

The theme of all these early romances is a quest or search. Whether it is the Holy Grail the knight is seeking, or a lost mistress or mother or father; whether he is seeking forgiveness for a sin or for lack of faith in his lady; or whether he is merely seeking adventure for its own sake—there is always a quest.

The people of the Middle Ages loved to hear of heroes of their own as well as of other lands and times. In France they wanted to hear of Charlemagne, the great king who had conquered barbarian and Saracen (*see* Charlemagne). They liked to hear of his nephew, the legendary Roland, who had died fighting bravely against such great odds (*see* Roland). Other cycles of stories grew up about King Arthur and the Knights of the Round Table, various heroes of the Crusades, and Alexander the Great.

Stories that Grew with Age

These bright romances grew sometimes to enormous length, as singer after singer embellished the tales handed down by word of mouth and added new episodes in response to the eager demands of his listeners. At first such tales were nearly all in verse, but later prose stories began to appear. An immense body of these romances still exists, written down by various singers and later collected.

To modern taste many of these romances seem fantastic or childish stories, strung loosely together at tiresome length. Yet there is hardly one without its elements of charm and passages of striking beauty. 'Amadis of Gaul' is one of the most interesting. Whether the original of this story was French, Spanish, or Portuguese no one can decide; but it is, as someone has said, "the prose epic of feudalism." The adventures in this 14th century story range from Scotland to Turkey, and giants, enchanters, and magic chambers fill it with amazing incidents. Although Cervantes wrote his 'Don Quixote' especially to ridicule the old romances, he declared that 'Amadis of Gaul' is "the best of all books of this kind that have ever been written."

To English readers the most important group of romances is that dealing with King Arthur and the Knights of the Round Table, and the search for the Holy Grail (*see* Arthur, King; Galahad; Round Table). In prose form the legends of King Arthur are preserved in the famous work of Sir Thomas Malory, 'Morte d'Arthur', and in poetry they have been adapted by Tennyson, Swinburne, and other poets. In fact, the Arthurian legends have served as the richest storehouse of romance from which the English poets have drawn. Perhaps even more important is the fact that these medieval romances contain the germ from which the modern novel has sprung, and that the name has been retained to denote

the type of fiction in which the imagination is given free rein to deal with extraordinary events and characters of transcendent virtues and vices as in the stories of the Middle Ages. (*See* Novel.)

ROMANCE LANGUAGES. The French, Italian, Spanish, and Portuguese languages, different as they are today, are all direct descendants of Latin, the language of the Romans. When Roman colonists spread over Europe as far north as the German forests, they took their language with them. This common language of Europe underwent many curious and interesting changes when learning died out under the barbarism of the Dark Ages. Even in the days of the Roman Empire, the Latin spoken by the people in the various provinces varied considerably, and these differences, influenced by the native tongues of the conquered peoples, by racial character, by geography, and by many other causes, finally transformed the various dialects into languages so different that one who does not know Latin can hardly see any point of resemblance. This group of languages is called the "Romance" group from the fact of their common descent from the Roman tongue. Because they are all derived from Latin, a knowledge of Latin is a great help in learning them. In addition to the four languages mentioned, the Romance group also includes Rumanian and several minor tongues, including a French dialect called Provençal, which was formerly spoken in the south of France and was chiefly used by the troubadors or medieval minstrels.

ROMAN HISTORY. When the curtain rises upon the pageant of Roman history, it discloses the destined mistress of the world a tiny settlement on the Palatine hill, one of the famous seven hills, about 17 miles from the mouth of the Tiber, in central Italy. At this point the river was easily fordable and so merchants from the south had settled here to trade with the powerful, wealthy, and more civilized Etruscans who occupied the lands to the north. The settlement of the Palatine was made by men known as "Latins," who dwelt in the little plain of Latium (the modern Campagna). On the nearby hills were other settlements, the most important of which seems to have been made by Sabines. They, like the Latins, were one of the Italic peoples which had pushed down from the north about 1000 B. C. and conquered the original inhabitants of the peninsula, a dark people of the so-called "Mediterranean" stock. Another branch of the great Indo-European stock had invaded Greece at about the same time. (*See* Etruscans; Races of Mankind.)

The various settlements on the seven hills finally joined to make one city, with common laws, social organization, and religion. At first the Latin chieftains

AT THE CENTER OF ROME'S LITERARY CIRCLE

Vergil is reciting a poem, perhaps one of the Georgics, in which he celebrates the husbandman, or a part of the Aeneid, written to the glory of Rome, while laurel-crowned Horace awaits a chance to read an ode or two. The bald-headed man at the right is Maecenas, a lover of the arts and letters and a generous man of wealth whose name has ever since been a synonym for a patron of poets and painters.

ruled, but before long—perhaps as early as 750 B.C. —the community fell into the hands of Etruscan princes from across the Tiber. Under their enlightened though despotic rule Rome grew steadily in importance and power, and great temples and public works were constructed, notably the huge sewer, the *Cloaca Maxima*, which stands to this day. After about two and a half centuries, however, their cruelty and tyranny caused a revolt which resulted in their expulsion. From that day the name of "king" remained so hateful to the people that even the most despotic of rulers in the later days of the Roman Empire never dared assume the title.

At first the Romans had no written records, and the traditions of their early history became so intermingled with fable that historians have difficulty distinguishing fact from fancy. These legends tell how Romulus ruled for 37 years after he founded the city in 753 B.C. (*see* Romulus); and how he was followed by Numa Pompilius, a wise and pious ruler who, under the guidance of his wife, the nymph Egeria, is said to have taught the Romans the arts of peace and the worship of the gods. Under his successor, Tullus Hostilius, the Romans conquered Alba Longa, the religious center of the Latin people. In this war took place the famous contest between the Horatii and the Curiatii, three brothers from the opposing sides who were selected to decide the struggle by personal combat. The Roman champions won, and not long afterward Alba Longa was destroyed and its people moved to Rome. During the reign of Ancus Martius, the next king, many troublesome Latin cities were conquered and their inhabitants brought to Rome. This ruler is said also to have built Rome's seaport Ostia at the mouth of the Tiber.

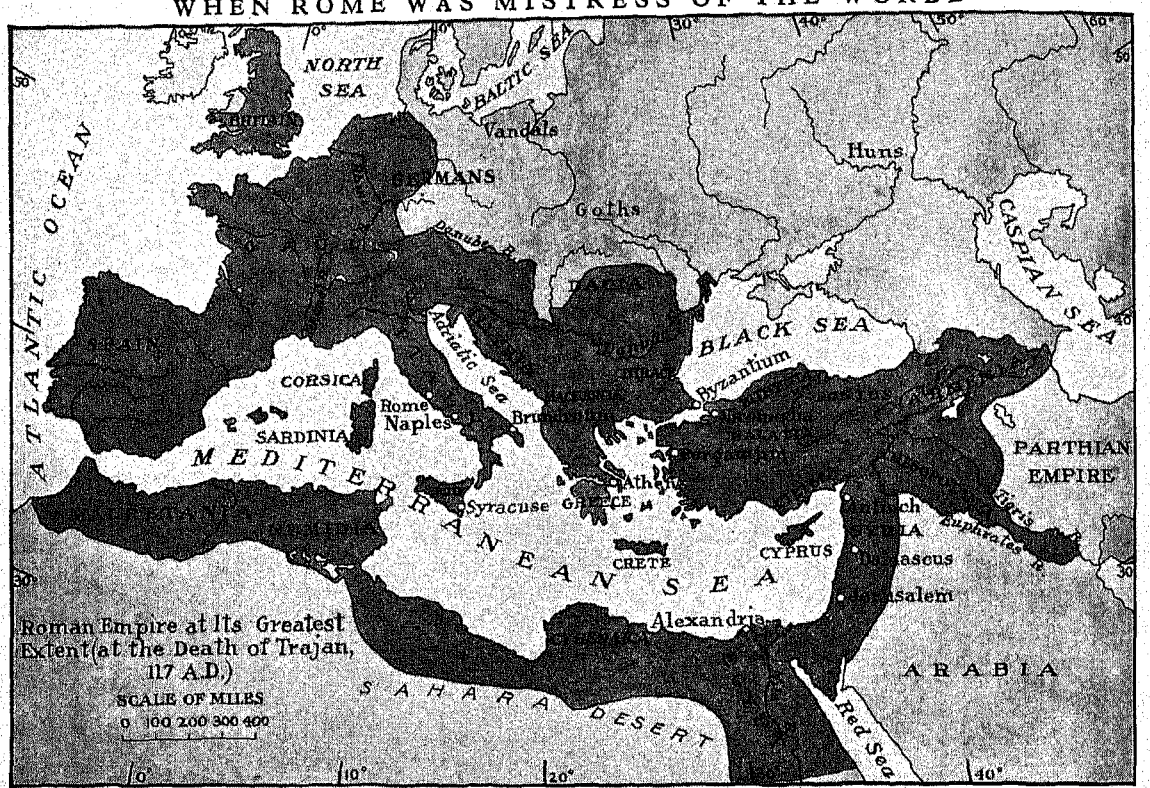
Rome Becomes a Republic

Tarquinius Priscus, the first of the Etruscan kings, drained the city, improved the Forum, the commercial and political center of the town, founded a temple to Jupiter, and carried on many wars with the neighboring peoples. Under Servius Tullius, the sixth king, a treaty was made with the Latin cities acknowledging Rome as the head of all Latium. Servius Tullius enlarged the city, the story goes on, and built a wall around all seven hills. The last of the kings, Tarquinius Superbus, was a tyrant and oppressor of the people. He scorned religion, but was induced to buy the famous Sibylline books that thereafter were the chief guidance of Rome in the hour of need (*see* Sibyls). A rebellion against him was led by Junius Brutus, who drove him from the throne (510 B.C.). Rome now became a republic.

Four times the banished Tarquin attempted to regain his power. First, he enlisted the aid of Brutus' two sons. When their treachery was discovered, the stern old father, true to the ancient Roman ideal of duty, condemned them both to death. Next, the men of Veii and Tarquinii, two Etruscan cities, marched on Rome to force Tarquin's restoration. Brutus was slain in the fight, but the Romans won the day. Next, Lars Porsena, an Etruscan prince, seized a height across the Tiber from Rome. The city was saved only by the heroism of Horatius and two companions, who held off the whole Etruscan army while the Romans destroyed the bridge (as you may read in the story accompanying the article on Tiber River). Finally Tarquin stirred up his son-in-law, Octavius Mamilius, chief of all the Latins, to lead a revolt. But the Latins were crushed in the famous battle of Lake Regillus, in which, the story goes, the Romans were aided by Castor and Pollux.

The young republic which now set out on its long career of almost incessant warfare was far different from the great republics of today. It was only a tiny city-state, much like the city-states that were flourishing at the same time in Greece. Its area was less than 400 square miles and its population perhaps 150,000. Chief power was in the hands of the wealthy and aristocratic citizens, called the "patricians," who were supposed to be the descendants of the three original tribes of Rome. The common citizens, the "plebs" or "plebeians," at first had little more to do with the business of government than they had had in the days of the kings. But bit by bit they tore down the barrier which separated the two orders, and the internal history of the republic for the next three centuries is largely the story of how the plebeians wrested reform after reform from the patricians.

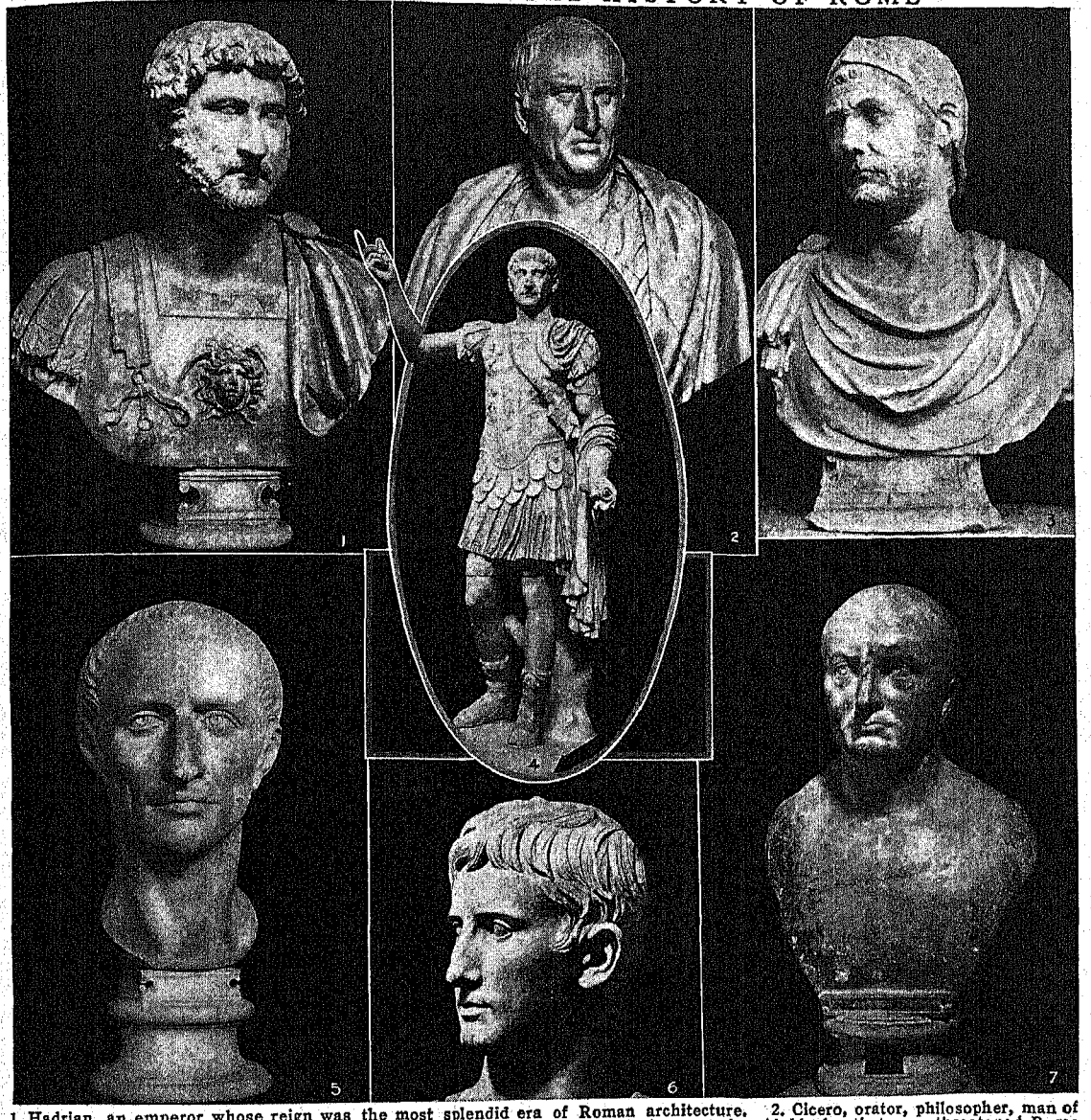
WHEN ROME WAS MISTRESS OF THE WORLD



As your eye travels along the shaded portions of the map girdling the Mediterranean, it takes in virtually the whole of the ancient civilized world. From the Atlantic to the Caspian, from Britain to the Red Sea, from beyond the Rhine and the Danube to the deserts of Africa, a hundred million souls, perhaps, in Europe, Asia, and Africa, were bound together in a far-flung empire such as the world was not to see again until the rise of the British Empire.

In the early days of the republic the ruling power was divided between two patrician magistrates, elected for one year. These were the "consuls." The assembly in which they were chosen (the *comitia centuriata*) was made up of divisions apportioned in such a way that votes of the patricians counted for much more than those of the far more numerous plebeians. The Senate, the most important political body, consisted of 300 men chosen by the consuls from the patricians. Thus shut out from office and political power, the plebeians were grievously oppressed by their wealthy fellow-citizens. True, they were protected from the worst dangers of arbitrary power by the *lex Valeria* (Valerian law) passed in 509, which provided that whenever the life or rights of any citizen were at stake, he could appeal from the

HEROIC FIGURES IN THE HISTORY OF ROME



1. Hadrian, an emperor whose reign was the most splendid era of Roman architecture. 2. Cicero, orator, philosopher, man of letters, statesman. 3. Hannibal, greatest of all Carthaginian generals, and the most formidable foe that ever threatened Rome up to the day of its downfall. 4. Trajan, the soldier-emperor under whom the Roman Empire reached its greatest extent. 5. Julius Caesar, orator, soldier, empire-builder, uncrowned monarch in the last years of the Republic. 6. Augustus, the heir of Caesar and the first emperor in name. 7. Scipio Africanus, great general, victor at Zama over Hannibal.

magistrates to the assembly of the people. But they suffered from unjust debt laws and from unfair distribution of the "public lands"—the territory won by conquest.

When a Whole Nation Went on Strike

To redress their wrongs the plebeians resorted to what might be called a "general strike." In 494 B.C. they marched out of Rome in a body and threatened to make a new city. The "first secession" so terrified the patricians that they agreed to cancel all debts and release those imprisoned for debt. Furthermore the plebeians were granted the right to be represented by new officials, called "tribunes," who should have the right to veto the act of any magistrate which bore unjustly on any citizen.

From this beginning, the plebeians went on to gain other rights. They soon won recognition for an assembly of their own (the *concilium plebis*), and forced the appointment of a commission of ten men (*decemvirs*) to put the laws of the state in writing and have them engraved on 12 tablets of bronze (450 B.C.). They gained the right of intermarrying with the patricians (*lex Canuleia*, 445 B.C.) and obtained admission to the various public offices one

after another. The chief of these, which were established to relieve the consuls of the growing burdens of administration, were those of *quaestors*, or treasurers; *censors*, who kept the lists of the citizens, assessed taxes, and supervised public morals; and *praetors*, or judges. The struggle was long drawn out, and it was not until 367 that it was decided that one of the two consuls should be a plebeian. In 350 the plebeians were admitted to the dictatorship, which was an extraordinary magistracy whereby supreme power at critical times was given to one man (*see* Cincinnatus).

Admission to these offices carried with it admission to the Senate, since vacancies were filled from those who had last been elected to public office. The Roman Senate of the republican period has been called the "most distinguished and important political body which has ever existed in the world." Its members were appointed for life, and executives were bound to submit to it all important measures. In theory it was a purely advisory body, but since its members were ex-magistrates, representing the highest ability and influence of the state, any advice it gave was almost certain to be accepted, for no magistrate would dare challenge such a body unless he was prepared to back up his act by force of arms.

The growing power of the plebs was marked by the gradual rise of a new voting body, the *comitia tributa*, in which one man's vote counted for as much as another's. This developed from the plebeian assembly (*concilium plebis*, which still continued to meet) by allowing patricians also to participate. After the passage of a law (*lex Hortensia*) in 287 B.C. making the acts of the plebeian assembly binding on all the people, these two bodies made most of the laws.

The Struggle between Rich and Poor

Side by side with the struggle for political power went on the economic struggle between rich and poor. The wealthy landowners continued to increase their estates, appropriating the best of the lands and increasing their herds until they monopolized the public pasture. They continued the practice of lending money at ruinous interest to the small proprietors, reducing them to slavery when they could not pay. Moreover, the population of Rome was increasing too fast, and the soil was becoming poorer because of the primitive farming methods. The burden of constant warfare fell most heavily on the plebeians, who had to leave their little farms to fight the state's battles. Gradually, however, reforms were forced through, chief of which were the Licinian laws of 367, which again revised the debt laws, limited holdings to 300 acres, and compelled the large landowners to employ a certain proportion of free laborers.

While these momentous changes were taking place at home, the little city-state had been gradually extending its power. Compelled at first to fight for its very existence against powerful neighbors, Rome gradually fought her way to the leadership of the Italian peoples and so paved the way that was to lead to the conquest of the world.

The most formidable of its early foes had been the Etruscans. With their greater numbers and superior civilization, the Etruscans would probably have reduced Rome to vassalage but for the destruction of their fleet in a war with the Greek city of Syracuse in Italy (474 B.C.), and the constant pressure of the Gauls from the north who swarmed into the Po valley toward the end of the 5th century and laid waste the Etruscan cities of the north. Thus aided, the Romans had finally been able (396 B.C.) to take, after a ten years' siege, the powerful Etruscan stronghold of Veii, eight miles from Rome.

When the Gauls Sacked Rome

In its conflicts with this foe and with neighboring Italic tribes (chiefly the Aequians and Volscians), Rome was supported by the other Latin cities to the south which were united under the name of the Latin League and had made a treaty with Rome for mutual defense. The victorious progress of Rome received a temporary setback in 390, when wandering Gauls advanced through the heart of Etruria, laying waste the land as they went, and captured and sacked Rome. Legend tells how the garrison on the Capitol Hill was aroused in the nick of time by the cackling of the sacred geese, and repulsed the storming party. After a fruitless siege the Gauls accepted a heavy ransom and returned to the valley of the Po. Though Rome had been burned, the Etruscans had suffered far worse in the invasion and were so weakened that Rome was able to seize their southern possessions and in another century to conquer their whole territory.

Meanwhile the Latin League had become restive under the growing power and arrogance of their ally and attempted to break away from its control. From the two years' war which followed (340–338), Rome emerged victorious, reducing some of the towns to vassalage, giving others full Roman citizenship, and others partial citizenship (the "Latin right").

Another formidable foe in central Italy still remained to be reckoned with, the Samnites, who were also of Italic stock. The first conflict with this warlike people (343–341) had been interrupted by the Latin revolt. The truce then made was broken a few years later (326) and a desperate struggle continued, with interruptions, until the decisive battle of Sentinum (295) made Rome supreme over all central and northern Italy.

Only southern Italy, occupied by a disunited group of Greek city-states, remained independent. Its fate was not long delayed. Alarmed at the spread of Roman power, the Greek cities appealed to Pyrrhus, king of Epirus in Greece. He inflicted two telling defeats on the Roman army and then crossed to Sicily to aid the Greek cities there to throw off the yoke of Carthage. Encouraged by the arrival of a Carthaginian fleet, Rome renewed the struggle, and in 275 repulsed Pyrrhus in the battle of Beneventum (*see* Pyrrhus). One by one the Greek cities were taken, and Rome was mistress of all Italy.

ANCIENT ROMAN TOOLS AND UTENSILS

1. A Roman lantern found near Pompeii. 2. Medical instruments. 3. Pottery vase, showing typical ornaments. 4. Baking pan for small cakes. 5. A glass urn, to hold ashes of the dead. 6. Iron sword and bronze-plated scabbard, found in the Thames near London. 7. Scissors, thimble, and two keys. 8. Saw, hammer-head and T-square. 9. Skillet, found in England. 10. A strainer. 11. A bronze jug.

Nowhere did Roman genius shine with greater brilliancy than in the system which was gradually devised to weld these immense conquests into a contented and unified whole. Instead of treating the conquered cities of Italy as mere subjects, to be exploited for the interests of the conqueror, Rome granted many of them the privileges of Roman citizenship, in full or in part, as she had done with the Latin cities. Most of them were given the status of "allies," with self-government and the right to trade and intermarry in Rome, but not to vote. Furthermore all Italy was dotted with colonies of Roman citizens, most of whom retained their full civic rights. Considerable territory, nearly one-sixth of all Italy, was annexed and distributed among Roman citizens. Thus a common interest in the welfare of Rome was spread throughout the land.

Two centuries of warfare had now made Rome a nation of soldiers. Her only remaining rival in the western Mediterranean was the Phoenician colony of Carthage, which was the chief naval power as Rome was the chief land power. Carthaginian warships made the western Mediterranean a closed sea, and sunk the trading vessel of any other city which dared to bid for a share of the rich commerce of this region. Such a condition was intolerable to the pride of Rome,

and a conflict for Mediterranean supremacy (the Punic Wars) began in 264 B.C., which continued with interruptions until Carthage was finally destroyed in 146. The courage and endurance of Rome were tested to the utmost in this "most wasteful and disastrous series of wars that has ever darkened the history of mankind." The war with Hannibal (the Second Punic War), one historian asserts, was "a trial such as no people has ever gone through before or since, and survived." But the stern devotion to duty, which was the keynote of Roman character, prevailed in the end, and after the battle of Zama (202 B.C.) Carthage was reduced to the status of a vassal state. Fifty years later, with savage vindictiveness, Rome again attacked her prostrate rival and razed the city (Third Punic War). (*See* Carthage; Hannibal.)

Winning World Mastery

Rome was now well launched on her way to world dominion. One conquest led to another. Upper Italy (*Gallia Cisalpina*), Sicily, Spain, Macedonia, Greece, and Asia Minor were subdued and made Roman provinces. Intoxicated with their sudden rise to imperial power, the new generation of statesmen departed from the wise policies of their great predecessors and gave themselves over to ruthless aggression and spoliation. Most of the conquered lands were administered by governors (*proconsuls*), who ruled like oriental despots with the sole aim of amassing in their one year of office wealth for a lifetime. Such enormous taxes were wrung from the subject peoples that they not only defrayed most of the expenses of the Roman state but enriched the greedy tax-farmers (*publicani*), who purchased the privilege of collecting the taxes. Wealth poured into Rome from the four corners of the globe, and the ancient simplicity of Roman life gave way to Asiatic luxury and pomp. Morals were undermined; vice and corruption flourished. The suddenly enriched officeholders acquired estates, buying up the little farms of the poor peasants, who could not compete with the hordes of slaves that worked the great plantations. The streets of the capital were flooded with a poverty-stricken rabble—ruined farmers, discharged soldiers, and idlers from all Italy—who lived on state and private charity and on bribes bestowed by office-seekers.

Between the aristocracy of birth and wealth and the vast moneyless mob there was bitter hostility. War of class against class was bound to come. A few patriotic statesmen tried to avert the dreadful climax, but in vain. The Gracchi brothers, grandsons of the great Scipio Africanus who defeated Hannibal at Zama, came forward as champions of the people and proposed laws to redistribute the public lands and to limit the powers of the corrupt and selfish Senate. Both fell victims to the hatred of their foes, Tiberius in 133 B.C., and Gaius 12 years later.

The death of Tiberius marked the beginning of a century of revolution and civil war that ended in the downfall of the Roman Republic and the establishment of the Empire. Henceforward armies, not votes, were to determine the course of events. First of the popular military chiefs was Marius, who had become a national hero by capturing Jugurtha, leader of an insurrection in Africa, and almost destroying (102–101 B.C.) a horde of German barbarians (the Cimbri and Teutones) who had disastrously defeated four Roman armies one after another. In the year 90 the Italian allies, who had long in vain demanded full Roman citizenship, rose in revolt (the Social War). The struggle lasted two years and ended in the bestowal of the rights demanded.

Rivalry between Marius and Sulla, an adherent of the senatorial party, for command in a war against Mithradates in Asia Minor led Sulla to march with his troops on Rome. For the first time Rome was invaded by a Roman army. As soon as Sulla and his legions were safely out of the way in Asia, Marius in turn seized Rome with his army and massacred many of the senatorial leaders. On his victorious return in 82, Sulla took a fearful revenge, slaughtering more than 5,000 of the people's leaders and confiscating their goods. As "perpetual dictator" (81–79) he passed laws transferring supreme power from the people to the Senate, but in vain; the aristocrats were too corrupt and feeble to keep the reins of power.

The history of the remaining years of the republic resolves itself into a series of biographies of the great adventurers who now made themselves masters of the town and disrupted state, sometimes joining hands to make their position secure, sometimes waging savage civil warfare (*see* Caesar; Cicero; Pompey). The only thing that saved the vast edifice of Roman power from crashing to final destruction was the emergence of two statesmen of commanding genius, Caius Julius Caesar and his great-nephew Augustus (Octavian). Scrapping the old republican framework, except in outward form, they remolded the tottering structure into an empire, in which all power was gradually concentrated in the hands of a single ruler, backed by the might of the Roman legions. How this change was brought about is told in the articles on Julius Caesar and Augustus. (*See also* Cleopatra.)

Two Centuries of Peace and Prosperity

With the establishment of the empire, the century of civil strife, which had also seen almost constant warfare abroad, was followed by two centuries of profound peace broken only by frontier warfare. At home literature and civilization flourished, and in the provinces responsible men held power. More and more the Mediterranean world assumed the aspect of one great nation. Paved roads led from end to end of Italy, and into what are now France and Germany. Fragments of Roman roads still exist even in far-away Britain, aqueducts and bridges in France, and Roman wells in the Egyptian oases of the Sahara. Roman citizenship was extended to all free men throughout the empire and Roman law was administered in every court. In this period of tranquility, the new religion

THE ROMANS DEFY THE CONQUERING PYRRHUS

At the left is the ambassador sent by Pyrrhus to offer peace to the Senators, because he foresaw that it would be difficult to subdue the Romans, even though they had suffered heavy losses in the recent battle of Heraclea (280 B.C.). At first the Romans were inclined to welcome peace, but the aged Appius Claudius Caecus, the builder of the Appian Way, though so weak that he had to be carried into the Senate chamber, denounced the peace, and stimulated his fellow Senators to reply that Rome never negotiated with an enemy on Roman soil.

founded by Jesus of Nazareth had an opportunity to grow, slowly, but with comparatively little interruption, until in the reign of Constantine it became the official faith of the Roman Empire, and ultimately of the whole Western World.

But, though the "Roman peace" (*pax romana*) spread its beneficent aegis over the civilized world, though the remotest lands were ransacked to supply the wealthy citizens with luxuries and delicacies, though art and letters were prized and fostered, the national character was steadily decaying. Gone was the fundamental seriousness (*gravitas*) of attitude which marked all the conduct of Romans of the antique mold. Gone was the old reverence for the family, for the state, and for the gods. Prosperity had brought in the leaven of corruption. In place of a Brutus, offering up his sons on the altar of duty to the state, we find a Nero, murdering his mother and his wife at the prompting of a Poppaea. Selfishness had become the first law of life. The passion for a life of luxurious ease ruled in all classes. The rich amused themselves by giving feasts of unparalleled splendor; the poor had their *panem et circenses*—free bread and free shows. Slave labor had degraded the once sturdy peasantry to the status of serfs or beggars. The backbone of the nation, the middle class, had almost disappeared; there were only the very rich and the very poor. After the time of Diocletian the whole empire was put in leading-strings, and under the absolutism of one-man rule society became stagnant, politically, industrially, and mentally. Emperors could build up and maintain a bureaucratic organization of great efficiency, but they could not cure the cankers at the heart of the people.

The events of the imperial history of Rome need not detain us long. Augustus was followed by his stepson Tiberius (14–37 A.D.), a capable but unpopular ruler; then came the mad Caligula (37–41), whose life was ended by his own officers after he had reigned for only four years. Claudius (41–54) was not a strong ruler, but his reign left its mark on the history of the empire, for his generals conquered the southern part of Britain. The infamous Nero (54–68), was the last ruler of the line of Augustus, and his death ended the first century of peace (*see* Nero). For two years there were struggles for the throne between rival military commanders, and civil war was threatened, but with the triumph of Vespasian (69–79) the government again became stable. During the reign of Vespasian's son Domitian, a cruel half-mad tyrant, all Britain was conquered.

Domitian was followed by a line of five great emperors—perhaps the wisest and noblest line of rulers the world has ever seen. Nerva's brief reign (96–98) was followed by that of the great conquering emperor Trajan (98–117), under whom the empire reached its

A ROMAN FAMILY DINNER IN THE PERIOD OF DECADENCE

After Rome's conquest of the East, the sturdy simplicity that marked the Roman life of earlier times gave way to Oriental luxury and splendor. The women decked themselves in diamonds, pearls, and rubies from India and robed themselves in silks from China. Peaches, apricots, and other rare delicacies, then appearing for the first time in the Roman world, were brought at immense expense to furnish their tables. And, worst of all, her citizens became degenerate, like the corpulent gourmand at the head of this table.

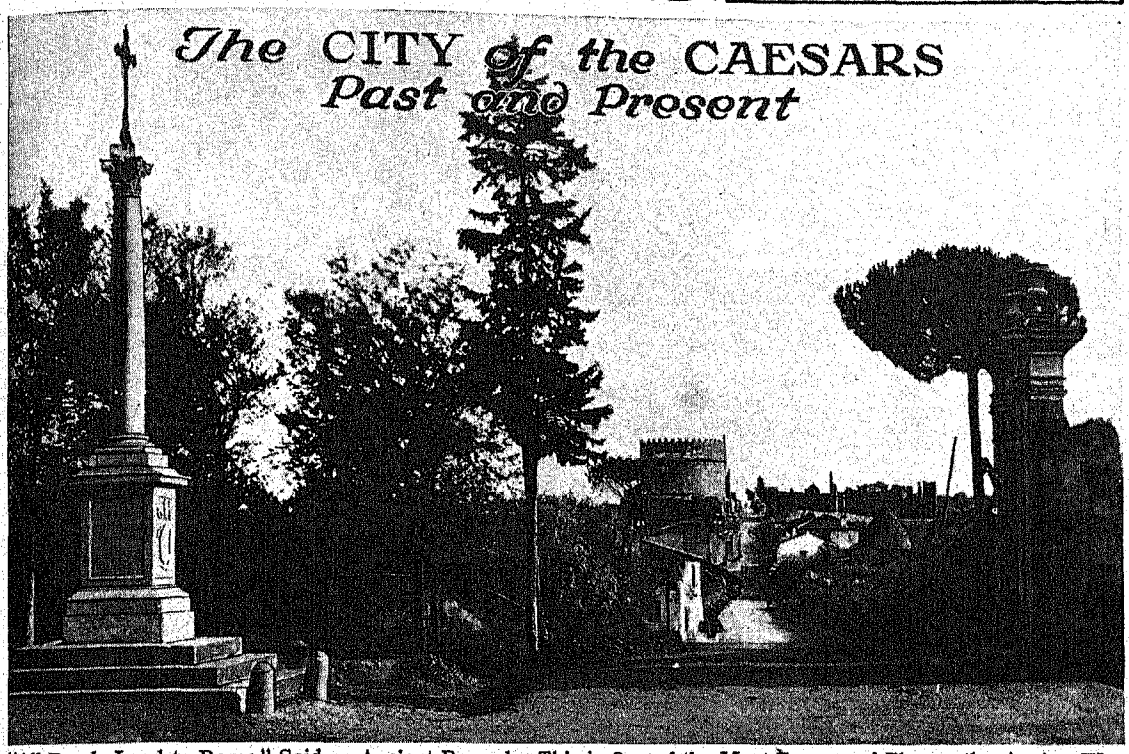
greatest extent. The capable and energetic Hadrian (117-138), consolidated and improved the organization of the empire and fortified the frontiers, building the great wall across northern Britain, parts of which stand to this day. The period of his wise rule and that of the philosopher-emperors Antoninus Pius (138–161) and Marcus Aurelius (161–180) was pronounced by one great historian to be the happiest era in the entire course of human history, if the welfare of the great mass of the population be considered. (*See* Marcus Aurelius Antoninus.)

After Marcus Aurelius, the decline of the empire set in. The legions had found that they could make emperors at will from among their own numbers, and they set up 80 such soldier-made rulers in 90 years. The flood was at length stemmed by Diocletian (284–305), but he stemmed it at the price of turning the Roman state into an oriental despotism, abolishing the last pretense of republican liberty. The Senate was now no more than the city council of Rome. Diocletian also took the first step that ultimately led to the division of the empire, entrusting an associate, "Augustus," with the government of the West, while he himself ruled the East. The decline in the importance of Rome that began with Diocletian was consummated when Constantine moved his capital to the Greek city of Byzantium on the Black Sea (330 A.D.), renaming it in his own honor Constantinople (*see* Istanbul).

The transfer of the capital meant ultimately a division of the empire. The story of the Byzantine Empire is a long and glorious one, that of the Western Empire from this time on merely one of weakness and decline (*see* Byzantine Empire). Gradually the northern barbarians seeped into Italy and in 410 Alaric took Rome. The Western Empire from that time became the prey of successive waves of barbarians. (*See* Alaric; Goths; Huns; Lombards; Vandals.)

In 476 Romulus Augustulus, the last of the imperial line in the West, who combined in his name that of Rome's legendary founder and that of her first emperor, was deposed by the barbarian leader Odoacer. The Roman Empire was at an end and the barbarian kingdoms of the Middle Ages were soon to take its place. But in reading the history of France, Italy, and Spain, you will realize that the end of the Roman Empire was in a way only its beginning. These new kingdoms governed themselves largely by Roman law, spoke forms of Latin, and professed the Christian religion. Thus, even though the great empire decayed and fell, Rome had won a new spiritual dominion, for the new faith spread throughout the lands which the Roman power had brought together but could no longer hold, and the seat of the great pagan power became the head of the Christian church, the fountain-head of western Europe's new faith. (*See also* Greek and Roman Art; Italy; Latin Language and Literature.)

The CITY of the CAESARS
Past and Present



"All Roads Lead to Rome" Said an Ancient Proverb. This is One of the Most Famous of Them—the Appian Way

"THE grandeur that was Rome" was spread like a mantle over the civilized world when Christ was born; and today the ruins of the empire and the priceless treasures of Renaissance and modern art make this city of the Caesars and of the Popes one of the most fascinating of spots to the inquiring traveler. Only less important is its place as the bustling capital of the new and growing kingdom of Italy formed a few score years ago.

ROME. Rome is, in truth, the Eternal City; we may say of it that its past and its present and its future are one. Time rolls back in Rome as in a book. We walk on the very dust of Caesar, and every step we take is on historic ground. Fallen Rome, the Rome which ruled the world for 500 years and had an extensive empire before Christ was born, is 20 feet under us wherever we go. Caesar's palace, Peter's prison, Paul's lodgings—they are the foundations of the modern streets of Rome. The huge area of the Forum has been laid open; here and there elsewhere a fragment has been dug up or a cellar excavated, and every day men uncover bits of the old Roman empire. But it is only bits, and Rome must be razed to the ground if the wondrous things beneath it are to be revealed.

What these wonders are we know in part. There are no ruins in the world so thrilling. The difference between Egypt and Rome is that the interest in Egypt is historical, the interest in Rome is human. We know almost nothing of Rameses II; we know almost everything of Julius Caesar.

And Rome brings Caesar as near to us as Napoleon. We walk across the place where Caesar lived. We stand on the spot where he was stabbed by Brutus. From the only authentic statue of him, on the Capitol, we can walk down into the great Forum, and read Mark Antony's speech in the place where Antony spoke and where he burned his friend's body before the people. That is the human touch of Rome, the kind of thing possible nowhere else.

All travelers to Rome first come to the Capitol and the Forum; there is no other site on earth in which is concentrated so much of the vital history of the world. Out of the little narrow streets we come suddenly upon a great flight of steps, handsome and steep. We run up, past the ancient statues, past the milestone from the Appian Way—which Paul must have looked upon and said, "Still seven miles to Rome"—past the cage of living wolves kept there in memory of Romulus, into the Capitol square. Let us go first into the Capitoline museum, and spend five minutes in the most amazing portrait gallery to be found anywhere.

Here, in a little room no bigger than a dining-room, are the Roman emperors, with their wives and families and friends, imaged in marble by those who knew them. You feel here, as nowhere else, that these men were *real*, and you know what we mean when we say that Rome impressed its image upon the world for all time. For here is Rome; here are the Caesars. Here is Julius; next to him Augustus and his mother. Here is the great philosopher-emperor Marcus Aurelius as a boy, then as a man; then his

wife, then his daughter, then her daughter's husband. Then his son and successor, the brutal Commodus, who was murdered, and the wife who murdered him. Here is Nero's mother, the shameless Agrippina the younger, who killed her second husband Claudius (also here) to make way for her son. Then Nero himself, who in turn killed his mother, and then his wife, whom he kicked to death before he killed himself. The best and worst of rulers that the world has ever seen—all are here!

We sit before these men, seeing their character and destiny in their faces. Surely they are the most thrilling marbles in the world. But we leave them, pass the statue of the 'Dying Gaul' in the next room, and come back to the square.

In the middle is the fine equestrian statue, in bronze, of Marcus Aurelius, the emperor and philosopher who lived before Christianity had made its way, and who might have changed the history of mankind if he had been born a little later. Among the faces that we meet in Rome are some that haunt us as we go about, and we never forget the face of Marcus Aurelius, or the half-sad thoughtful face of the young Augustus.

The Ruined Splendors of the Forum

Let us leave the Capitol and come down to the Forum on the other side. It is disappointingly small to the eye at first; but it grows and grows, and lengthens and lengthens, and widens and widens, until it is a very wilderness of doom. We must have in our minds a clear notion of what has happened in the Forum since the days when this place was the central architectural glory of the world. As the history of Rome was submerged by the coming up of other nations, so the very monuments of Rome were buried in the dust of centuries.

The palaces of the Caesars fell. Their temples broke in pieces, and hundreds of years of ruin left Rome a rubbish heap. Throughout the Middle Ages the buildings of ancient Rome were robbed of their beautiful columns and stones to build the frowning castles of prelates and princes, or their marbles were burned into lime, to make mortar for peasant dwellings. By the time the 12th century came, the place where these marvels had stood was an impassable wilderness of rubbish. Orchards and gardens sprang up where temples had been, and the avenues of triumphal processions were covered with teams of buffaloes and oxen. The peasantry grazed their cattle in the Forum; mechanics set up workshops here; and only a few tops of columns standing out from the earth suggested the wonders that lay beneath. The very name of the Forum was forgotten, and so little was to be seen that, at the beginning of the 19th century, Lord Byron wrote of what is now one of the highest columns in the Forum, and called it "the nameless column with the buried base."

That nameless column is named now; its base is revealed, and it stands in the center of the most remarkable excavations that the eye of man can see.

Stroke by stroke men have carried on these excavations, and the thought that comes is of the wonderful sight that Rome must have been in all its glory! If only we could take the lid off all that remains! Four street-levels have been found, and the levels of the streets of ancient Rome lie sometimes 24 yards down, and never less than 8 yards down, from the level of the streets today. Broken columns, ends of temples, beautiful porticoes, ruined halls, mosaic pavements, rostrums, altars, fountains, inscriptions, lines of broken statues, houses with three stories, steps leading down to cellars and up to churches, enormous walls of red brick stripped of their original marble, exquisite reliefs, triumphal arches—all stretching across the vast space which begins at the base of the Senators' huge palace and reaches to the arch erected by Titus after the destruction of Jerusalem, with the Colosseum and the Arch of Constantine in the background. On the right, high up like a ruin in the skies, is the palace of the Caesars.

The traveler is bewildered as he stands amid this ruin, and tries to picture what this place was like once upon a time. Here in the Forum, in the days when emperors walked about among the people, were 25 acres of halls and temples and triumphal arches; 1,200 marble columns and 1,000 colossal statues; miles of porticoes, shops full of treasures, galleries full of great pictures; the Senate House and the Archives of the Empire of the World.

And it was not a show, all this wonder; it was not only to look at, but to *endure*. It was a thing of beauty made to be a joy almost forever. So well did they build, these Romans, that columns stand today in the open streets of Rome where they were set up 2,000 years ago. So well they did everything that the great drains of the city—including the Cloaca Maxima, near the Forum—are still in use today. They are big enough, as a writer said 2,000 years ago, "for a hay-cart to pass through."

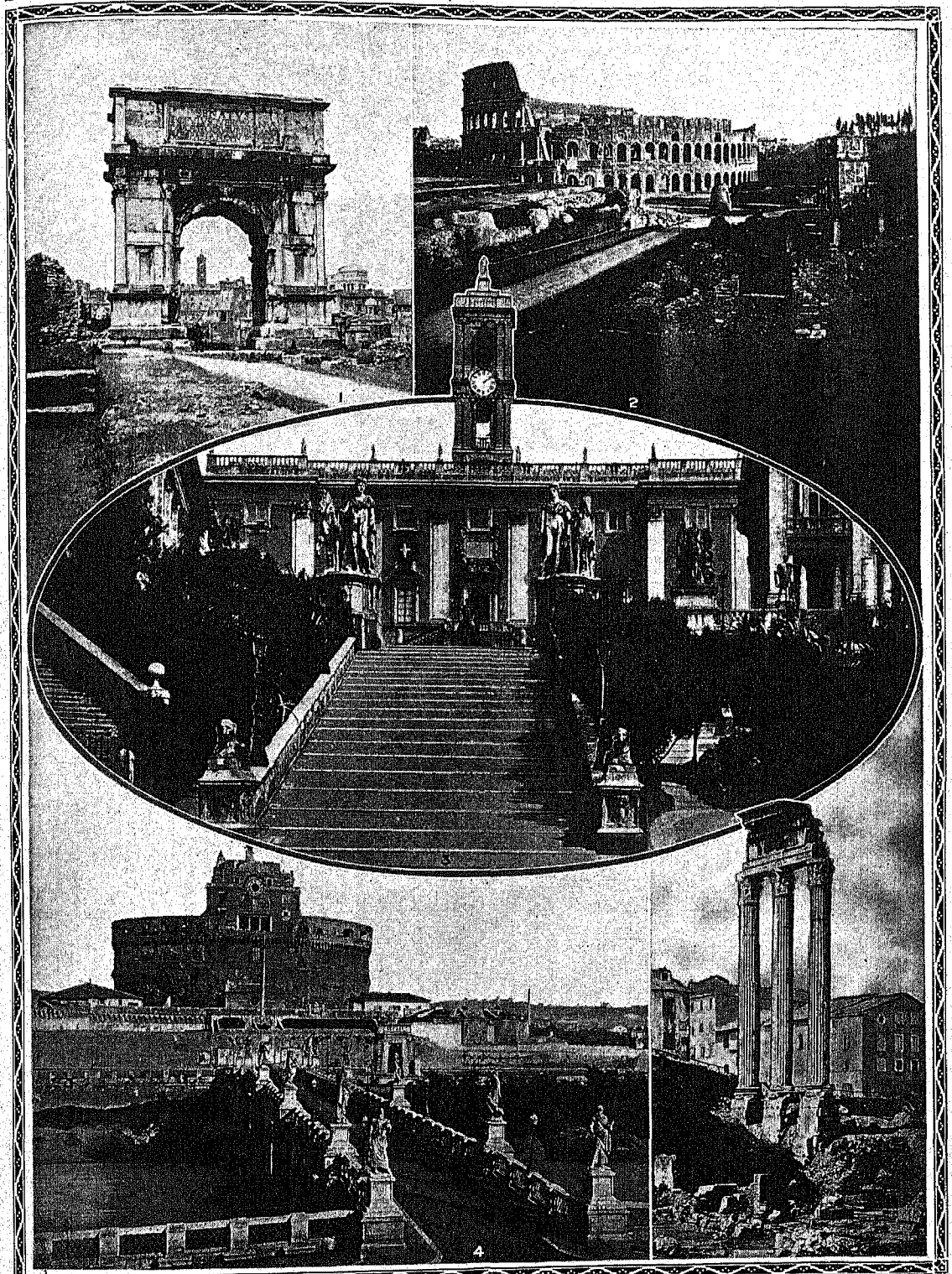
In this Forum where we stand, the history of Rome was made. It is almost true to say of Rome that *everything* happened here.

Imagination almost reels to think of the gigantic splendor of this place in days when Rome was Rome indeed. It is wonderful to see the vastness of the ruins; to go round to the left of the Colosseum and see it *whole:* then, walking slowly around, find that this great thing is a broken fragment!

Where Christians Fought Beasts

The mind simply cannot picture the Colosseum as it must have been when it was dedicated by the emperor Titus in 80 A. D., yet palaces and temples and tombs have been made of marble taken from this simple ruin. Twelve thousand captive Jews are said to have been engaged in building this huge place, of which the outside walls alone cost more than $50,000,000. Three times around the outside walls is a mile, and the walls rose high enough toward the sky to hold 20 tiers of seats for 50,000 people; and in the

SPLENDORS OF ROME, ANCIENT AND MODERN



1. The Triumphal Arch of Titus, conqueror and destroyer of Jerusalem. 2. The Colosseum, built in the reign of Vespasian, and long the scene of gladiatorial contests and other games; it could accommodate 50,000 spectators. 3. Palace of the Senators, which houses the civil administration of the modern city; its façade was built in 1591 from designs by Michelangelo. 4. Castle Sant' Angelo, built by Hadrian as a mausoleum, for fifteen centuries the fortress of Rome, connected with the Vatican by a secret underground passage, but now only a showplace. 5. Ruins of the Temple of Castor and Pollux, on the south side of the Forum.

midst of them, on a throne of ivory or gold, sat the emperor. A thousand beasts were slain in this arena to keep an emperor's birthday, and how many human death-cries have gone up from this place nobody on earth can know!

Once upon a time there were 400 kinds of plants among the ruins, and the first seeds of many of them may have come from the cages of wild beasts brought from distant lands. So that it is a thrilling thing to pull a leaf or to pick a flower that is growing here, for we hold in our hand a living thing that may go back to a great day at the Colosseum, when hungry lions were let loose on the early Christians "to make a Roman holiday."

Yet even the great Colosseum can never have seemed so dazzling to the Romans as the very ruins of it seem to us, for the world in which they moved was so luxurious that one of them wrote complaining that he could "hardly tread except on precious stones." A theater built for a ceremony of two or three days only is said to have been the greatest work ever made by the hand of man. It had three stories —one of marble, one of glass, and one of gilded wood; and the bottom story was supported by 360 marble columns, between which were 3,000 statues.

Gigantic Baths of Olden Days

There have been counted in Rome today 9,000 columns of marble still unbroken, and it is said that there must have been in former days 450,000 of these columns at least. Some which have been found were six feet across. We have only to walk into the baths of Caracalla, or into the baths of Diocletian just outside the railway station, to see how utterly words fail to describe the vastness of these buildings. Diocletian loved big things, and it is said that he set 40,000 condemned Christians to work laying out these baths, with their lovely mosaic floors and wonderful marble walls, to cover 400,000 square yards and to accommodate 3,000 bathers. Such was the splendor of Rome!

And while pagan Rome lived in pomp and splendor in the sun, her future conquerors were hiding underground. Down in the tombs were the persecuted Christians, driven to worship, and perhaps to live, among the dead. Forty groups of catacombs have been found outside the gates of Rome, cut out sometimes five tiers deep in the ground, so that we may walk about in them today at a depth of 40 feet below the surface, and walk so far in them that, if we went from end to end, we should travel more than 500 miles, or half as far as from Chicago to New York. Down in these tombs were the persecuted followers of the Carpenter of Nazareth, whose apostles had been led out of the gates to be crucified. The pagan Romans would have laughed if somebody had said that these poor men hiding underground were founding an empire greater than their own; yet today there are two things that take the world to Rome. One is the ruins of the emperors, the other is the monuments of the men they persecuted.

The great wonder that grows upon the traveler in Rome is the wonder of the Two Empires. Think of the fact that at one time there were in Rome on the same day two such men as Nero and Paul! Nero lived in a golden house; Paul was in chains. Yet Nero's empire has gone—you can hardly find a fragment of Nero in Rome today; he is the deadest of the emperors. Paul's empire has come, and it endures forever. Peter and Paul fill Rome today!

In the Steps of Peter and Paul

Few things can interest the traveler more than to go from spot to spot and hear the still small voice. You could hardly hear it in Rome 1,900 years ago. Go down into the catacombs, and realize that 1,900 years ago there were but a handful of Christians in Europe and that they had to hide down there! See their secret chapels, their graves, their paintings on the walls. The emperors were on the Palatine, in the Forum, at the Colosseum; the Christians, if they were not being torn to pieces by the lions, were singing in the catacombs.

We follow Paul and Peter everywhere; stand where they stood, go into the house where, perhaps, Paul wrote his letter to Philemon; look over the house of Pudens, wonderfully well preserved. We ride along the Appian Way, by which Paul came to Rome—miles of it we ride along, between miles of broken tombs. We pass under the gate through which he walked to the place where he suffered death.

Strange is it to reflect that here was a great civilization *before* Christianity; that Christianity came into the very heart of it and was crucified; that the classical civilization ceased to be, the greatest power in the world broke down, and the persecuted Christianity inherited its greatness, establishing its empire throughout the earth for all ages to come, so that today, when the Caesars are so dead that men store coal in their palaces and drink liquor in their tombs, the great glory of Rome is the tomb of the fisherman Peter, whom Nero crucified!

The Sublime "Jewel of Rome"

For St. Peter's is the jewel of Rome. We should be careful in calling a thing sublime, but St. Peter's *is* sublime. Out of a long mean street, we emerge into the vast square, where George Eliot felt that nothing small or mean could come. Everybody knows the picture of it, with the half-circle of high columns leading to the ends of the façade, about 150 yards in front of you. There are hundreds of these columns in four lines, and through the middle avenue a carriage and pair can pass. Each front column has a statue on the top. The vestibule is perhaps 50 yards long, and looking down from the ceiling are probably 20 statues, almost lost in the vastness, though they must be of enormous size. As we walk slowly toward the tomb of St. Peter, under the central dome, the beauty of the place grows upon us and becomes a dream; we lose the world of sense, and live as in a vision. Nothing but the sight of it can convey to us a sense of its great beauty.

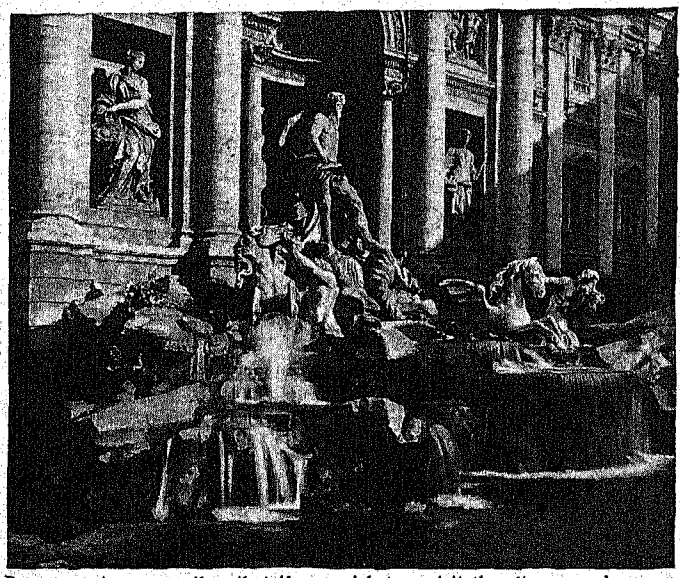
THE FORUM OF ROME, THEN AND NOW

A famous painter has here rebuilt the Forum on canvas. The scene is the festival of Castor and Pollux, annually held on the anniversary of the battle of Lake Regillus. The Romans believed that the battle had been decided in their favor by the intervention of the twin gods. The temple dedicated to them (at the extreme left) was the scene of this yearly ceremonial.

Of the great buildings of the Forum only a few ruins remain, but even these have traces of their antique beauty. Finest of them are the three columns at the left, all that remains of the temple of Castor and Pollux. At the extreme right is the Arch of Septimius Severus and between them the open ground of the Forum, broken only by the fragments of statues.

Perhaps there is no dome like this anywhere. It is as light as can be, and its simple decorations—probably 80 pictures on a soft gold ground, in slanting panels—can be easily and clearly seen, though they are so high that the lettering has to be longer than a man, and a pen in St. Luke's hand is longer than St. Luke himself, in order that we may see it naturally.

Four huge pillars, each vast enough to occupy the space of a thousand standing men, hold up the dome, and around the church are a dozen other domes, over a dozen chapels, all bigger than the average church, and unspeakably more lovely.



Roman custom prescribes that if you wish to revisit the city some day, you should drop a coin into the waters of the famous fountain of Trevi. This beautiful confusion of rocks and sea-monsters, marble and travertine, forms one wall of a palace erected in 1735 by order of Pope Clement XII. The water supply comes from an aqueduct nearly 13 miles long built in 19 B.C. by Agrippa.

ROMAN FOUNTAINS AND CARTS ARE SIGHTS TO REMEMBER

The peasants around Rome take pride in their gay carts. Each peasant designs and paints his own, stretches the collapsible, one-man top over slender tree branches, paints the same design on the ends of his olive oil barrels, and thus he identifies them when he goes to collect "empties" from the oil merchant, for no two patterns are alike.

And as we wander in this great place, seeming to grow more spacious and more lovely as we walk about it, we come to feel that it is one of the world's master-places. As one dome passes out of sight and another comes into view, as the rich gold of the great arches strikes the eye, as the great mosaics and frescoes come—one of them representing nine men's work for ten years, 90 years of human labor—as the white marble tombs loom before us, the great silence of the place growing upon us all the while, we are overwhelmed! Its size is stupendous—636 feet in length, while the tip of the cross on the huge dome is 435 feet above the ground. No wonder that after Pope Julius ordered it built in 1506, it took 126 years to carry out the plans!

The Wonders of the Vatican

Yet this marvelous place is only part of a place; it is only one part of the greatest building in the world today—the Vatican. If the Vatican stood alone in a desert, men would build a railway to it. It is, of course, the wonder-house of the world, as full of priceless treasure as the sea is full of salt; yet it stands not alone in its glory, but here in Rome among a thousand wonders. It is the greatest palace and the greatest church on the face of the earth.

It covers more than 13 acres. It is said to have a thousand halls and chapels and apartments, and on one ceiling alone Michelangelo gave up four hard-working years of his life. Whether this roof, or a roof that Raphael painted, is the greatest thing in art is an endless controversy among those who understand these things; but the Vatican will not be jealous whichever way the problem is decided, for both these roofs are here within its walls. Here Raphael painted for 12 years; here Michelangelo must have chiseled and painted for most of his long and glorious life.

Here is a gallery of pictures which no money in the world could buy; here are miles of sculptures, which speak of the world that was for ages and ages before the United States began. Here is Augustus, the mail-clad ruler of the world, who "found Rome brick and left it marble"; he who ordered the census which took Mary to Bethlehem and made a manger sacred and immortal, as the birthplace of an empire compared with which the empire of Rome was like a home of ants! Here he stands, this splendid Caesar, seeming, as somebody said, as if he were speaking those words: "Din of arms shall cease, and days of hardship shall be softened." Here, too, Demosthenes, chiseled by a man who knew him, his face caught at the moment when he is trying to catch the ear of a frivolous crowd by warning them of a danger to Athens, and we seem to hear him crying, "Oh Athenians, my countrymen, when I talk to you of political dangers you will not listen, and yet you crowd about me to hear a silly story about an ass."

THE ANCIENT AND THE MODERN CITY IN PANORAMA

Above is a model of the ancient city as it would appear if restored. In the foreground is the Colosseum, the playground of the Romans. In the view below you see another great circular space, but this is no playground. It is the vast Piazza San Pietro, where George Eliot felt that nothing small or mean could appear; fronting on it is St. Peter's, the greatest church in Christendom. From the dome of the church the modern Rome spreads out in a panorama which dwarfs even the splendor of the ancient city.

Here is the famous Laocoön, that terrible group of a father and his sons in the coils of a snake; one of the very greatest sculptures in the world, which stood in the palace of Titus, the conqueror of Jerusalem, who came back to Rome and set up a beautiful arch, on which is seen today a picture of the Temple swaying in its fall.

Here is the Sistine chapel, decorated with paintings by Michelangelo, most famous of which is 'The Last Judgment'. Two apartments are given over to the masterpieces of Raphael, including his celebrated 'School of Athens'. Besides innumerable great paintings on the walls of its rooms and chapels, the Vatican contains six museums—the Clementine museum of Greek and Roman art, with the celebrated Apollo Belvedere; the Chiaramonti museum of classical art; the Gallery of Inscriptions, where some of the most valuable records of early Rome are kept; the Etruscan museum, with relics of prehistoric Latin peoples; the Egyptian and the early Christian museums. In the Vatican library also are more than 40,000 manuscripts, making it the greatest single source of accurate historical knowledge in the world.

But it would need books and books and books to tell us of what is here; and so packed with wonderful things is Rome that a book could only begin to describe it. Through the heart of the town runs the famous Corso, the chief modern street of Rome. At one end of it is the convent where Luther stayed on that visit to Rome which opened his eyes and sent him out into the world to start the Reformation. Not far away sleeps the man who perhaps may have kept the Reformation out of Italy, Ignatius Loyola, who took a little band of men into a chapel here and swore them to be faithful, and founded the Order of Jesuits which has covered the earth. A little distance off sleeps Fra Angelico, whose pictures travelers love to

see; and beneath the altar of that same church, with the lights that never go out shining in the dimness, is the figure of a lady in a tomb with a glass front and two burning lamps in it—Catharine of Siena, the revered mystical saint of the 14th century.

But it is thus everywhere in Rome—wonder and terror are in the air. Beneath one of the most imposing monuments lies a pope who was born so low that he had no name; under the very dome of St. Peter's lies a man who was once an English beggar-boy. And so on forever—for it is not possible even to mention here a thousand things that travelers go to Rome to see.

We wonder at the narrow unpaved streets made of lava-stone, at the confusion of men and horses and automobiles mixed up everywhere. We wonder at the sound of running water in the streets, especially at night, when the trickling of the fountains is weird and odd. We are puzzled by the hills of Rome, where at times the next street is up an elevator or through a long white tunnel or up a hundred steps—and perhaps Michelangelo made the steps. We wonder at the frescoes on the outside walls of houses, lit up sometimes at night with electric lamps; and if we are passing a great house in the dark we may be startled, perhaps, by the appearance of white figures seeming to step out into space from niches in the wall. We start back at the sight of living wolves close to us on the Forum steps. It is part of the weird mystery of the Eternal City, the spirit of the Colosseum, the memory of the Forum—the something that creeps out of Caligula's palace at night and fills the air with the terror of the Past.

Once you go to Rome there will come into your life something that will never leave it until life ends; and you will want to go to Rome again and again and again, to feel yourself a far-off looker-on, through the veil of centuries, at the greatest pageant Time has ever seen.

Aspects of the Modern City

And now let us take a somewhat closer view of the "City of Seven Hills." Without doubt it surpasses all other cities in the world in historic interest. Not only was it the capital of the great empire which first brought to a large part of Europe law and orderly government and the arts of civilized life; it remained the center of European life in the Middle Ages, and is today at once the capital of the government of modern Italy, and the seat of the papacy, the head of the great Roman Catholic church.

Historians are agreed that the greatness of Rome is entirely man-made. Its geographical situation is unfortunate. Lying on the narrow Tiber River, 17 miles from its mouth, it has none of the advantages of a seaport, and the comparatively barren plain surrounding the low hills of the city was until recently covered with unhealthful marshes, breeding pestilence and disease. Now, through government enterprise, the dismal Campagna, including the stagnant Pontine Marshes, is being reclaimed and made healthful and useful as it was in the days of ancient Rome.

Modern Rome has expanded somewhat beyond the original seven hills—the Capitoline, Palatine, Aventine, Quirinal, Viminal, Esquiline, and Caelian hills. It now spreads over nine or ten ridges, none of which was ever very high, and all of which have been cut down until now they are hardly distinguishable. Until 1871 Rome was ruled by the pope as its temporal prince, and there were few residences on these historic hills. They were covered with vineyards and ruins, and the city proper was crowded down along the left bank of the Tiber on what used to be known as the *Campus Martius* (Field of Mars). The Palatine and Capitoline hills, once the centers of living Rome, with the nearby Forum, are now the chief spots where one may study the ruins of the past. At the foot of the Capitoline a modern monument to Cola di Rienzi reminds us of the ill-fated attempt of this "last of the Tribunes" to restore, in the 14th century, the long-vanished forms of the Roman Republic.

A City of Palaces and Hovels

Despite its ancient ruins and artistic riches, Rome today still lacks the imposing aspect of many other European capitals. The streets in great part are narrow and irregular, and palaces and hovels often exist side by side. In recent years a gradual transformation has been taking place. Broader streets are being opened and tunnels have been dug under some of the hills which interfere with traffic.

The part of the city which lies on the right bank of the Tiber is more open and modern in appearance. Here are the Vatican and St. Peter's and the broad spaces of Monte Gianicolo, the ancient *Janiculum*. The walls of the city, which on the left bank date back to the third century, are about 14 miles around and are pierced by 19 gates. The most important of these is the Porta del Popolo, through which passed the ancient *Via Flaminia*, the Roman highway to northern Italy. The old Appian Way left the city by a southern gate. Remains of other great roads may still be seen, relics of that vast system stretching over a great part of Europe, when "all roads led to Rome."

Between these two parts of the city the Tiber has a winding course of three miles, confined between stone embankments built in modern times to guard against its fierce floods. A dozen bridges connect the two portions of the city. The chief street of Rome today is the Corso Umberto Primo, which leads from the center of the old city out through the Porta del Popolo; it is named in honor of King Humbert I (1878–1900), who succeeded his father Victor Emmanuel II, first king of modern Italy.

The throngs of modern Rome present a cosmopolitan aspect hardly exceeded by Paris. Tourists from all quarters of the globe, soldiers in gay uniforms, *carabinieri* or military police with plumed hats, black-robed priests, and sandaled monks in brown or gray or white mingle with the peasants from the hills; while among them honk and rattle the automobiles of the rich and a host of yellow motor busses. Viewing

this throng, it is difficult to turn the imagination back to the days when solemn and magnificent processions of popes and cardinals moved through these streets, and to the remoter times when proconsuls and emperors led their conquering legions in triumph past acclaiming crowds of senators and people.

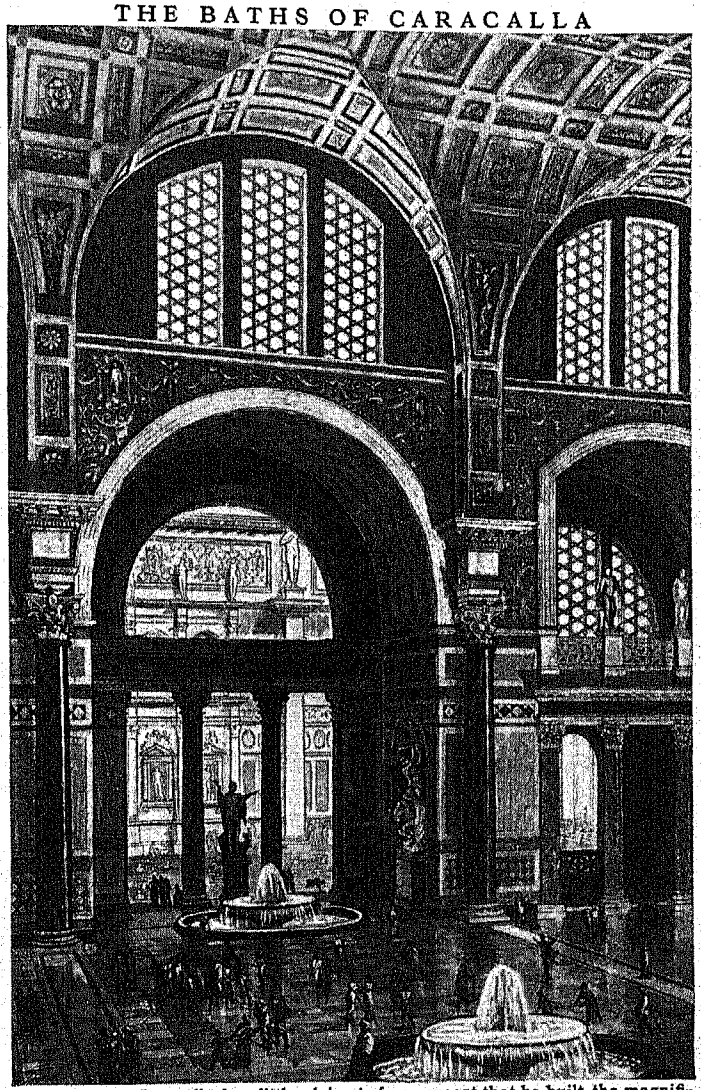
The Vatican hill is situated in the extreme northwestern corner of the city; and the papal residence, which was begun in the 13th century, while the popes still lived in the Lateran palace at the opposite end of Rome, was primarily designed as a sort of fortress in which the popes might be safe from attacks of foes inside and outside the city. The walls which almost completely surround it were built when the popes took up their permanent residence there in 1377. From behind these walls and with all approaches guarded by the Castle of Sant' Angelo—the massive tomb of the emperor Hadrian, long ago converted into a powerful fortress—the papal lords of Rome could easily dominate the city.

The palace of the Quirinal, which since 1871 has been the residence of the kings of Italy, is situated in the exact center of the old town, on the left bank of the Tiber. It has no great architectural merit, but it is the hub of a group of enlarged modern thoroughfares which radiate toward all points of the compass.

It is impossible to give a list of the many churches and palaces which possess historic and artistic interest. For centuries Roman pontiffs and cardinals and the Roman nobility vied with each other in erecting magnificent palaces and places of worship. Next to St. Peter's, the church of St. John Lateran is perhaps the most important. It is the mother church of Rome and was the scene of the five famous Lateran councils.

Among the palaces made famous by the names of the great nobles are those of the Borghese, the Farnese, the Rospigliosi, and the Colonna. These were built in the turbulent days when a man's home was literally his castle, and many a bloody fight was fought before these doors between defenders within and besiegers without.

THE BATHS OF CARACALLA



The Emperor Caracalla has little claim to fame except that he built the magnificent bath house, of which the picture is an idealized restoration. Bathing was a social institution in the later days of Rome, and the larger *thermae* or baths accommodated two or three thousand people. Within the great luxuriously adorned central hall, fashionable idlers gossiped away much of the day.

Few buildings of the days of the republic or early days of Christianity remain standing in Rome today. In view of the violence suffered by the city during many centuries, it is surprising that a single stone is left in place. A dozen times enemy forces camped within the walls and gave the city over to pillage. On five of these occasions immense damage was done. The Gauls thoroughly plundered the city in 390 B.C. Alaric and his Visigoths sacked Rome just 800 years later, in 410 A.D. The Vandals followed close on the footsteps of the Goths in 455, and by their furious destruction created the new word "vandalism." In 1084 the Normans of southern Italy, who had been called in by the pope, seized the opportunity to plunder the city. And finally the soldiers of "his Catholic majesty" Charles V, Emperor and King of Spain, ravaged Rome terribly in 1527. Greater perhaps than the destruction by any one of these invasions was that wrought by Romans themselves, who for ages plundered the structures of ancient Rome to obtain materials for their own buildings.

But despite the assaults of time and man, many remnants of Rome's ancient glory remain, for the Roman emperors built solidly and on a vast scale. For many years excavations have now been carried on and gradually the ground plan of the city of the Caesars has been brought to light. Perhaps the most famous series of ruins is to be found in the great Forum at the foot of the Palatine hill, including the remains of at least seven temples. The temple of Vesta, goddess of fire, with the home of the Vestal virgins near by, is the most noteworthy in this group. The best preserved of the ruins is the Pantheon, which has been a model for modern classic architecture the world over. It is now used as a church.

Everyone has seen pictures of the Colosseum, the great ruin which still stands in the midst of modern Rome. When it was dedicated as an amphitheater by the emperor Titus in the year 80 A.D., it was probably the richest and most imposing building in the world.

It is said that when the Romans began the habit of taking hot baths, the downfall of their empire set in. Their love for this form of luxury—for in those days of primitive plumbing it *was* a luxury—is shown by the many remains of *thermae* or bathing palaces scattered throughout the empire. The most noted of these in Rome are the baths erected by the mad emperor Caracalla, and those built by Diocletian, Nero, Titus, and Trajan.

In the Roman household plumbing was primitive. But the engineering feats by which they brought pure drinking water to the city were nothing short of marvelous (*see* Aqueduct).

Because of its many objects of historical and artistic interest, Rome today remains one of the great culture centers of the world. Of its many scientific and literary institutions, the university of Rome is the most important. The Catholic church maintains several large colleges for training priests and missionaries; and the United States, as well as some other countries, has here a school of classical studies. There are besides innumerable schools of art, architecture, and music, and Rome has one of the largest military hospitals in Europe.

Although electric power stemming from the Alpine falls has brought some industries to Rome, the city is of little importance as an industrial center. Its chief products are silk fabrics, jewelry, glass, and pottery. Population, about 1,155,000.

'ROMEO AND JULIET'. In this romantic Shakespearean tragedy, old Capulet, head of a noble house in Verona, Italy, invites his friends and kinsmen to a masque in honor of his beauteous only child, Juliet, whereat it is his hope she may be betrothed to the rich Count Paris. Young Romeo of the house of Montague, whose ancient feud with the Capulets has filled the city streets with many brawls and duels, dons a disguise in sport and mingles with the invited guests for a dance or so. No sooner does he set eyes on the exquisite beauty of Juliet than he has fallen irrevocably in love with her and she with him. They are secretly wedded by their father confessor, the Friar; but before the wedding day is spent Romeo is provoked into slaying a Capulet, and is straightway banished from Verona. Old Capulet now commands Juliet to prepare for immediate marriage with Count Paris. To save herself, she swallows a drug given her by the Friar, by whose action she is thrown into a deathlike trance until word can be sent to Romeo to come and bear her away with him. But Romeo hears that she is dead. He arrives frantic at Verona, breaks into the tomb where Juliet lies, and at the foot of her bier ends his life. Waking from her trance and discovering the sad miscarriage of her plan, Juliet makes Romeo's dagger the instrument of her own death and dies upon his body. Thus the children of the Capulet and the Montague become "poor sacrifices of their enmity," and by their deaths heal the ancient feud.

One of the most enchanting scenes in literature is found in this play—the famous balcony scene in the garden of the Capulets, where Juliet is wooed by Romeo, and in return discovers her love to him. The whole is in language of purest passion and poetry. Thus Romeo, observing Juliet at her window and seeing that her lips move, is stirred to ecstasy—

> I am too bold. 'Tis not to me she speaks:
> Two of the fairest stars in all the heaven,
> Having some business, do entreat her eyes
> To twinkle in their spheres till they return.

And Juliet, sighing to the night, astonishes and delights his ear with this—

> O Romeo, Romeo! Wherefore art thou Romeo? . .
> What's in a name? That which we call a rose
> By any other name would smell as sweet;
> So Romeo would, were he not Romeo called,
> Retain that dear affection which he owes
> Without that title. Romeo, doff thy name
> And for thy name, which is no part of thee,
> Take all myself.

ROMULUS AND REMUS. The Romans were very proud of their origin, for they believed that the father of Romulus, the mythical founder of Rome, was Mars, the god of war. His mother, the daughter of King Numitor of Alba Longa, was said to be descended from the great Trojan hero Aeneas, a son of the goddess Venus. According to the legend, a brother of King Numitor usurped the Alban throne and ordered Romulus and his twin brother Remus to be thrown into the river Tiber. They were miraculously saved, however, and were nursed and cared for by a she-wolf, until discovered by a shepherd who brought them up in his home.

When the brothers grew up, they decided to found a city on the banks of the Tiber; but in a quarrel which arose over the naming of the city Remus was slain. Romulus then built the city, which was called by his name, and invited all outcasts and fugitives, so that it grew very rapidly. After having firmly established his city and made peace with the neighboring people, Romulus was caught up to heaven, during a terrible storm, to dwell with his father Mars. Afterwards he was worshiped by the Romans as Quirinus.

The PRESIDENT *Who* STOOD *for a* "NEW DEAL"

ROOSEVELT (*rō'zĕ-vĕlt*), FRANKLIN DELANO (born 1882). Two men bearing the name of Roosevelt have been elected president of the United States. The first was Theodore (1901–1909); the second was Theodore's fifth cousin, Franklin, who was elected in November 1932 to succeed Herbert Hoover.

Both were descendants of Claes Martenszen Van Rosenvelt, who emigrated from Holland to America about 1649. First of the Van Rosenvelts to drop the "Van" was apparently Jacobus, grandson of Claes. His son Isaac further changed the name (which means "field of roses") to "Roosevelt." Isaac, builder of the first sugar refinery in New York, took a leading part in city affairs. During the American Revolution he aided in drawing up the state constitution for New York and was later a state senator.

Franklin, the son of James Roosevelt and his second wife, Sara Delano Roosevelt, was born on Jan. 30, 1882, on the family estate at Hyde Park, N. Y. Private tutors gave him his early education, which was varied and augmented by trips to Europe. On vacation days he played tennis and other sports, learned about farming, and hunted specimens for a bird collection.

At fourteen his parents gave him a 21-foot sailboat in which he cruised in the Bay of Fundy and along the Maine coast. His love of the sea became one of the great passions of his life. He read widely about naval history and began a collection of books about the subject that ultimately grew into one of the most extensive in the country.

After a preparatory course at Groton School he entered Harvard in the fall of 1900. There he played on the freshman football squad, and rowed on the freshman club crew. But he did not make the varsity in either football or rowing, for although he was six feet one and a half inches tall he weighed at this time no more than 150 pounds. In various other lines of activity he took a conspicuous part, especially as manager and later president of *The Crimson*, the college paper.

Franklin was graduated from Harvard in 1904 and that fall entered the Columbia Law School. In March 1905, while still a law student, he married Anna Eleanor Roosevelt, his sixth cousin, daughter of his deceased godfather Elliott Roosevelt and niece of President Theodore Roosevelt. The President himself came to New York to attend the wedding and gave the bride away. After graduating from Columbia in 1907 he entered the practise of law with a distinguished firm in New York City, ultimately specializing in admiralty law.

From an early age young Roosevelt had been much influenced by his great kinsman, Theodore Roosevelt, with whose career his own was to run a curious parallel. Theodore Roosevelt was constantly preaching the doctrine that young men of ability, training, and independent means should enter politics and help raise the tone of public life. Though Franklin Roosevelt differed from his great relative in politics, this advice struck a responsive chord in him. In 1910 he became a delegate to the New York state Democratic convention, and the same year ran for the state senate from the district that included Dutchess, Columbia, and Putnam counties.

The district normally was strongly Republican, but Roosevelt, as he used to say, "loved nothing so much as a good fight." He toured the district by automobile and showed an unusual ability to win the support of a great variety of people. Much to the surprise of the politicians, he was elected.

Thus, like his famous distant cousin, he began his public career in the state legislature. There he displayed great political independence and fought vigorously many of the measures of Tammany Hall, the powerful New York City Democratic organization. By leading an insurgent movement that defeated the Tammany candidate

ROOSEVELT'S ADMINISTRATIONS

Commencing in 1933

- Banking Holiday proclaimed and Gold Standard suspended (1933)
- Agricultural Recovery Program started under AAA (1933)
- Tennessee Valley Authority organized (1933)
- New securities issues brought under Federal control (1933)
- Industrial recovery program started under NRA (1933)
- Banking laws revised and bank deposits insured (1933)
- Federal Unemployment Relief provided (1933)
- Prohibition, or Eighteenth, Amendment repealed (1933)
- Stock Exchanges brought under Federal regulation (1934)
- Federal Housing Program launched (1934)
- Reciprocal Tariff Act (1934)
- Federal regulation of Communications companies (1934)
- NIRA and AAA declared unconstitutional (1935)
- Social Security Act (1935)
- Federal control of Interstate Public Utilities (1935)
- Right of collective bargaining guaranteed to Labor (1935)
- Soldiers' Bonus Act (1936)
- Reorganization of Supreme Court defeated (1937)
- Fair Labor Standards Act (1938)
- New Agricultural Adjustment Act (1938)
- Neutrality Laws (1935–1937, 1939)
- Executive Departments Reorganized (1939–1940)
- Largest peacetime Defense program set up (1939–1940)
- Re-elected for third term (1940)
- "Lend-Lease" Act (1941)
- War with Axis Powers (1941)

for United States senator after a prolonged and bitter battle, he made himself nationally known.

Roosevelt early became interested in the presidential aspirations of Woodrow Wilson, who had been elected governor of New Jersey the same year that Roosevelt won a seat in the New York legislature. He became a leader in developing and organizing Wilson sentiment in New York. With others he arranged to take to the Democratic national convention at Baltimore a large unofficial delegation to assure the delegates from other states that, although Tammany Hall opposed Wilson's nomination, the great mass of New York Democrats wanted him and that if nominated he could carry the state. He also made contacts with a number of Democratic leaders, among them Josephus Daniels of North Carolina, who a little later was to be secretary of the navy.

In November 1912, in the election in which Wilson was chosen president, Roosevelt himself was returned to the state senate. The speaker in that body was Alfred E. Smith, a Tammany assemblyman from New York, with whose political fortunes Roosevelt's were subsequently to be strangely intertwined.

Navy Service in First World War

A few days before Wilson's inauguration Roosevelt went to Washington and while he was there Josephus Daniels, with Wilson's approval, offered him the post of assistant secretary of the navy. He accepted, resigned from the New York senate, and removed to Washington.

The administration as a whole was opposed to warlike preparations, but Roosevelt constantly urged in reports, speeches, interviews, and magazine articles greater naval preparedness. In this he reflected the views of Theodore Roosevelt and Leonard Wood rather than those of Woodrow Wilson and William Jennings Bryan. After the sinking of the *Lusitania* his views became more popular in official circles. He ultimately came to feel that the United States would be drawn into the war and did what he could to get the navy ready.

When war did come, the supply bureau and the navy yards, of which he had charge, were organized to function at top speed to build the ships and supply the equipment needed for a personnel suddenly increased from 72,000 to 497,000. Officers called Roosevelt "a steam engine in breeches," and Secretary Daniels said: "Roosevelt's energy made him do the work of several men." The need of haste and the necessity of improvisation naturally resulted in some mistakes, but no accusation of graft was ever made against his management.

Among the naval enterprises he helped to bring about was the laying of a great barrage of mines from the Orkney Islands to the coast of Norway to prevent German submarines from leaving the North Sea by the northern route. This barrage, 230 miles in length, was ultimately laid at a cost of $80,000,000; it included more than 56,000 American and a smaller number of British mines. Admiral Sims, a biting critic of some phases of the navy department's activities, called the barrage "one of the wonders of the war." It was undoubtedly a factor—how great can never be known—in bringing about the German collapse.

In July 1918, and again after the armistice, Roosevelt went to Europe on a destroyer and inspected the American naval establishment in European waters. While abroad he met many naval, military, and political notables, including King George, Foch, Lloyd George, and Clémenceau.

The 1920 Campaign for the Vice-Presidency

In the Democratic national convention at San Francisco in 1920 he served as a delegate and worked for the nomination of Gov. Alfred E. Smith, but Gov. James M. Cox of Ohio was nominated. Roosevelt's prominence and public services, together with geographical reasons, led to his selection as the candidate for the vice-presidency. With Cox he visited Wilson at the White House, and they promised the stricken President to continue his fight for the Treaty of Versailles and the League of Nations. Both kept their promises loyally, although it appears that Roosevelt at least never felt that the League in its existing form was entirely satisfactory. Roosevelt made a strenuous nation-wide campaign and delivered more than a thousand speeches. The tide, however, was running strongly against the Democratic party, and the swing of the political pendulum brought the Republicans back into power again. Roosevelt cheerfully resumed the practise of law in New York and also became vice-president of the Fidelity and Trust Deposit Company of Maryland, in charge of its New York office.

Presently there came to him what appeared a great misfortune. In the summer of 1921 he left New York City, where infantile paralysis (*polyomyelitis*) was prevalent, for a vacation at his cottage on an island in the Bay of Fundy. The trip was made on a friend's yacht, and on the way they ran into stormy weather. Roosevelt, who knew the coast well, took the wheel and after many strenuous hours brought the yacht safely into harbor. A day or two later he helped to stamp out a small forest fire, took a two-mile run, and then went for a swim in the bitterly cold bay. A chill resulted and two days later, when he tried to get out of bed, he found that he could not move his legs. Specialists pronounced his affliction infantile paralysis. He recovered from the acute attack, but his legs continued to be practically useless.

A Valiant Fight to Regain Health

With most men this physical misfortune would have meant the end of any active career. But Roosevelt, with characteristic family determination, still "loved a good fight." Determined to put life back into his almost helpless legs, he exercised them patiently and methodically. He continued active in his business and profession and even engaged in politics. He helped to bring about the election of Al Smith as governor in 1922, and aided in his reëlection two

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FRANKLIN D. ROOSEVELT

years later, but refused Smith's suggestion that he take the nomination for United States senator.

Three years after his attack, though still on crutches, he stood before the Democratic national convention in New York and placed in nomination for the presidency his friend Smith, whom he termed "the Happy Warrior." After the longest contest on record, between Smith and William G. McAdoo, the nomination went to John W. Davis.

Meanwhile Roosevelt did not give up the battle to recover further use of his legs. He studied his ailment, and in 1924 he heard of Warm Springs, Ga., where the water kept at an almost constant temperature of 88 degrees. A young Southerner similarly afflicted had been greatly benefited by using the pool; so in the fall of 1924 Roosevelt went thither. Every day for hours he bathed in the warm pool and moved his legs slowly but persistently. He returned to the springs from year to year. Ultimately he recovered to the extent that he was able to walk with some assistance, to drive a car, and even to ride horseback. Eager to help others who had been crippled by the same disease, Roosevelt by 1930 raised about $700,000 and established at Warm Springs a foundation that acquired the pool and built a sanatorium.

Drafted for the New York Governorship

Although he refused to run for office while battling to regain his health, he retained his interest in public affairs. In 1928 he again made the chief nominating speech at the Democratic national convention in behalf of Alfred Smith. This time Smith was nominated. Smith and his friends, anxious to carry New York, besought Roosevelt to run for governor. He repeatedly declined but finally was virtually drafted by the Democratic convention. Even more robust than before his illness, he canvassed every section of the state. In the election Smith lost New York by slightly more than 100,000, but Roosevelt carried it by 25,000. In 1930 he was reelected governor by the record plurality of 725,000.

Power control, reforestation, aids to agriculture, unemployment relief, and improvement of labor conditions were Roosevelt's chief aims during his two terms as governor. As state senator he had supported laws providing for factory inspection, workmen's compensation, and the protection of women and children in industry. As governor he continued to work for other measures for the benefit of the workman. One of his notable achievements was obtaining the passage of old-age pension laws.

Roosevelt believed that the state is responsible for the welfare of its citizens. Widespread unemployment in the summer of 1931 put his theory to the test. By doubling the income tax, the legislature raised $20,000,000, and New York thereby became the first state to augment local relief funds by state appropriations.

State control of public utilities, especially hydroelectric power, was a conspicuous article in Roosevelt's creed. Tremendous power lay at the very door of the Empire State—the St. Lawrence River with its proposed hydroelectric development. He favored the development of this power under state authority for distribution by private companies. But he declared that if private agencies would not give adequate service at reasonable rates, he would have the state itself take over the management and operation of the power and light business.

Winning the Presidential Nomination

Meanwhile the race was on for the Democratic nomination for the presidency. Roosevelt's reëlection to the governorship of New York, a pivotal state and the one having the greatest number of electoral votes, made him the logical candidate, and he made a frank effort to win the nomination. Democratic prospects for victory were bright, and a number of other candidates sought the prize. Among these were Governor Ritchie of Maryland, John Garner of Texas, and Al Smith of New York. Smith and his followers felt strongly that he had sowed the seeds of victory in 1928 and that now he should be entitled to reap the crop. The fight became a bitter one, and the ancient friendship between Smith and Roosevelt was broken. In the struggle for delegates Roosevelt took a decided lead; and in the convention at Chicago the Roosevelt forces, in control of the organization, chose the temporary and permanent chairmen. The platform denounced Republican rule as responsible for the hard times and declared for repeal of the 18th (Prohibition) amendment.

On the first three ballots Roosevelt received a majority over all, but fell short of the required two-thirds. Then a combination was arranged between the Roosevelt and Garner forces, and Roosevelt was nominated. The Smith forces, in particular Tammany Hall, viewed the outcome with bitterness and refused to permit the nomination to be made unanimous. Garner was named for the vice-presidency.

His Pledge of "A New Deal"

Instead of waiting to be notified of his nomination in the usual way, Roosevelt flew to Chicago in an airplane and appeared before the convention to accept in person. In concluding his speech, he said to the delegates, "I pledge you—I pledge myself—to a new deal for the American people." In this fashion he began his usual energetic type of campaign, which took him into many states.

Owing to the hard times the tide was running strongly against the party in power, and almost any man could have won on the Democratic ticket. President Hoover took the field himself and made a vigorous effort to turn the tide, but in vain. On Nov. 8, 1932, the Democrats swept the country even more completely than had the Republicans four years before. Roosevelt and Garner were elected by the largest majority of electoral votes in the nation's history. In both houses of Congress the Democrats had huge majorities.

In the interval between the election and the inauguration a tragic occurrence took place. While

Roosevelt was visiting Miami, Fla., a radical of foreign birth named Giuseppe Zangara fired several shots at him. Roosevelt received no hurt, but five other persons were injured, and one of them, Mayor Anton Cermak of Chicago, ultimately died of his wound. Zangara was quickly tried and executed.

Surprises in Cabinet Selections

In selecting his cabinet, President Roosevelt surprised the country by including three former Republicans—Secretary of Agriculture Wallace of Iowa, Secretary of the Interior Ickes of Illinois, and Secretary of the Treasury Woodin of New York. He further broke with tradition by giving a cabinet post to a woman, Frances Perkins of New York, who became secretary of labor.

From the outset Roosevelt made considerable use of certain advisers, placed in departmental posts, in addition to his cabinet. This set of men soon became known as the "Brain Trust," since the men came mainly from university circles. Many of them were young and inclined to radical beliefs. Critics declared they were impractical theorists.

When President Roosevelt took office on March 4, 1933, the United States was entering the fourth year of one of the worst business depressions it had ever known. National wealth and the national income had shrunk to less than half of what they were in 1929. Exports to foreign countries had been reduced by more than two-thirds. All over the country factories and mines were closed or running at a fraction of their former output. Between 12 and 13 million workers were out of jobs and 22 million persons were dependent on public relief or private charities. More than 5,000 banks had failed.

The prices of farm products had dropped to less than half of what they were in 1929. Farmers by the thousand, unable to meet interest payments on their mortgages, had lost both land and homes; lack of income had led many rural communities to resume old-fashioned barter in trading for necessities. Many city home owners were also in desperate straits.

On Inauguration Day, business was virtually at a standstill. The people had lost confidence in the banks and a banking panic had followed. The governors of many of the states had declared temporary banking holidays or moratoriums. Stock and commodity exchanges had been forced to close.

Not since the day when Abraham Lincoln took office had any president faced so critical a situation. Action by the government—and *speedy* action—seemed imperative to save the nation from complete economic collapse. All the world was watching to see what the new president would do.

A Whirlwind Start in Office

President Roosevelt's inaugural address left no doubt that he would act, and act quickly. He asserted his belief that "the only thing we have to fear is fear itself—nameless, unreasoning, unjustified terror which paralyzes needed efforts to convert retreat into advance," and called on the people to support him in "a disciplined attack upon our common problems."

"We now realize as we have never realized before our interdependence on each other," he said; "that we cannot merely take, but we must give as well; that if we are to go forward we must move as a trained and loyal army willing to sacrifice for the good of a common discipline."

Making it clear that he considered the existing emergency to be no less critical than the emergency of war, President Roosevelt embarked on a program which temporarily concentrated in his hands executive power as great as that of any war-time president.

The day after his inauguration he proclaimed a national banking holiday (moratorium), forbade the hoarding or export of gold, and called a special session of the new Congress. In the 100 days before its adjournment Congress had enacted a body of legislation so sweeping and far reaching that it touched nearly every interest in the life of the nation. In its later regular session Congress modified or elaborated this legislation and added many other measures.

Leading Features of the "New Deal"

The "New Deal" program of relief and recovery authorized by this legislation had three chief objectives: (1) to provide direct relief; (2) to make individual property secure; (3) to establish a planned and controlled economic system by "putting the government into partnership" with industry, agriculture, and transportation.

1. Direct relief was provided by setting up a Public Works Administration (PWA) with a fund of $3,300,000,000 to finance national, state, and local public projects, and thus make jobs for the unemployed in the construction and other "capital" industries. A Federal Emergency Relief Administration (FERA) was created to distribute $500,000,000 among the states for direct relief of the unemployed. Three hundred thousand young men were put to work in the Civilian Conservation Corps (CCC) on reforestation, flood control, and similar projects, and on the development of national parks. In the winter of 1933–34 about four million people were given emergency employment by the Civil Works Administration (CWA).

2. To aid in making property secure, the administration undertook to lend vast sums to banks, industries, and individuals. The Reconstruction Finance Corporation had been set up under the Hoover administration in January 1932, with initial capital of $500,000,000 subscribed by the United States Treasury. It was to make loans on security to banks, credit agencies such as farm mortgage companies, and for certain other purposes, including government crop loans and aid to railroads. Later legislation had expanded the Corporation's duties to the point where it had well over $800,000,000 loaned when President Roosevelt took office.

To this organization the President and Congress quickly added several others. By an executive order

Roosevelt gathered many existing agencies into a Farm Credit Administration (FCA), with wide authority to grant aid to agriculture. A Home Owners' Loan Corporation (HOLC) was set up under the Federal Home Loan Bank Board (FHLBB) to help home owners refinance their mortgages. Later the government guaranteed the bonds issued by these bodies. Near the end of the regular 1934 session, Congress passed the Frazier-Lemke Act, granting radical moratorium relief for farm mortgages, and the President after some hesitation signed it.

New Policies for Banking and Finance

In the field of banking and finance, the first major permanent legislation was the Glass-Steagall Banking Act. This act forbade commercial banks to engage in the business of selling securities, empowered the government to subscribe for preferred stock in banks, and tightened the Federal government's control of banking generally. A radical addition to banking practise was the Federal Deposit Insurance Corporation (FDIC), which insured repayment, up to certain amounts, of deposits in banks which might close. The act was so drawn as to compel the adherence of virtually all banks to the plan.

A stringent Securities Act passed in 1933 aimed at protecting investors by requiring registration of new securities with the Federal Trade Commission and providing heavy penalties for misrepresentation in offering such securities for sale. In 1934 the government broadened its control of finance by the Securities Exchange Act. This provided a Securities and Exchange Commission (SEC) to license and regulate stock exchanges.

3. Even more radical were the measures intended to promote recovery of industry, agriculture, and transportation.

Codes for Industry

Under the National Industrial Recovery Act (commonly referred to as NIRA) President Roosevelt organized a National Recovery Administration (NRA) which was empowered to supervise the arrangement of voluntary trade codes for the various groups of industries. These "codes of fair competition" limited working hours, fixed minimum wages, recognized the right of labor to bargain collectively, prohibited child labor, and forbade unfair trade practises. While individual codes were being worked out, the President promulgated a "blanket code" for all business. Employers who signed the code and consumers who agreed to patronize the signers received "blue eagle" posters for display. It was expected that industry would voluntarily accept these codes, but "teeth" were put into the act, in the form of broad powers given the president to force all the members of an industry to comply with the code governing it.

For more than a year, the NRA was administered by Gen. Hugh S. Johnson. After his resignation control was turned over to three boards, and Donald R. Richberg, director of the Industrial Emergency Committee, became the dominant figure.

Through the NRA the administration hoped to increase purchasing power, spread employment, and curtail overproduction in industry. Through its twin, the Agricultural Adjustment Agency (AAA), it hoped to bring about a similar improvement in the economic condition of farmers.

Far-Reaching Farm Aid

In March 1933, farmers were getting half as much for their products as they were in the pre-war period of 1909–1914, while the goods they bought cost the same. Their purchasing power was cut in half. To restore the farmer's share of the national income to what it was in 1909–1914, it was thought advisable to stop overproduction in seven basic commodities: wheat, cotton, hogs, corn, rice, tobacco, and milk. The AAA paid farmers about half a billion dollars in rentals or benefits, in return for letting about one-eighth of their lands lie idle temporarily. The money was obtained by taxes on "processing" operations such as flour milling, meat packing, and cotton manufacturing. Marketing agreements were made with producers, processors, and distributors to eliminate price-cutting and other unfair practises.

These twin plans for the restoration of industrial and agricultural prosperity were supplemented by an unprecedented experiment in systematic planning for the business and social life of the vast Tennessee River drainage area of 42,000 square miles—about as large as Ohio. Under the Tennessee Valley Authority (TVA) Act, the government was to operate the Muscle Shoals power and nitrate plants for power and for producing cheap fertilizer. The project called for reforestation, checking soil erosion, and developing industries suited to the region, in scattered units which would keep people "close to the soil."

Assistance for the railroads, which had been operating at a loss, was provided by appointing a Federal Coördinator of Transportation to effect economies and increase efficiency. The most obvious economies, such as consolidating competitive services, were largely prevented, however, by the prohibition against reducing the number or pay of employees.

In 1934 the government extended its control to cover the entire communications industry, by placing telephone, telegraph, and radio companies under control of a Communications Commission.

Dealing with Housing

A vast program was launched for improving housing conditions. In addition to extending aid to owners of existing homes, the administration created a Public Works Emergency Housing Corporation (PWEHC) to finance slum clearance and erection of low-cost housing units in cities, with loans to municipalities and builders. Plans for improving rural housing included development of "subsistence homesteads"—units consisting of a house and ground upon which a family could raise enough to support itself, and earn cash by work in near-by industries. Development of such housing was entrusted to the Federal Subsistence Homesteads Corporation (FSHC).

ALPHABET OF THE CHIEF "NEW DEAL" AGENCIES

AAA (Agricultural Adjustment Agency), originally created 1933 and reconstituted in 1938 to bring farmers' share of nation's income back to level of 1909–14. It regulates interstate and foreign commerce in certain commodities to stabilize supplies and prices; and, with the coöperation of marketing and lending agencies, seeks to provide an "ever-normal granary." Division of the Department of Agriculture.

CAB (Civil Aeronautics Board), created 1940 to succeed independent Civil Aeronautics Authority (1938). It establishes airways and landing fields; licenses aircraft and pilots; regulates rates; promotes air safety. In the Department of Commerce.

CCC (Civilian Conservation Corps), created 1937 to succeed the agency known as Emergency Conservation Work (1933); provided employment and vocational training for needy young men through work in the conservation and development of natural resources. In the Federal Security Agency until abolished in 1942.

CCC (Commodity Credit Corporation), created 1933 to make loans to producers to finance the carrying and marketing of agricultural commodities. Division of the Department of Agriculture.

CSB (Central Statistical Board), created 1933 to coördinate federal and other statistical services. Duties absorbed by the Budget Bureau in 1939.

EHFA (Electric Home and Farm Authority), created 1935 to finance consumer purchases of electrical equipment in homes and on farms. Division of the Department of Commerce. Abolished 1942.

FAA (Federal Alcohol Administration), created 1935 to administer the federal liquor laws. Duties absorbed by the Bureau of Internal Revenue in 1940.

FCA (Farm Credit Administration), created 1933 to make long-term and short-term credit available to farmers and to farmers' coöperative marketing and purchasing organizations; assumed duties of Federal Farm Board (1929); system includes 12 districts, each with a federal land bank, intermediate credit bank, bank for coöperatives, and production credit corporation.

FCC (Federal Communications Commission), created 1934 to regulate interstate and foreign communication by telegraph, telephone, cable, and radio.

FCIC (Federal Crop Insurance Corporation), created 1938 to insure wheat producers against loss due to unavoidable causes and extended to growers of other crops. In the Department of Agriculture.

FDIC (Federal Deposit Insurance Corporation), created 1933 to insure the deposits of approved banks. Division of the Department of the Treasury.

FERA (Federal Emergency Relief Administration), created 1933 to relieve the hardships caused by unemployment and drought; abolished 1938, and its work carried on by WPA until 1942.

FHA (Federal Housing Administration), created 1934 to encourage residential construction, repair, and modernization by insuring loans and mortgages. Division of National Housing Agency.

FLA (Federal Loan Agency), created 1939 to direct all agencies lending federal funds, except those making agricultural loans. Abolished 1942 and functions transferred to Department of Commerce.

FSA (Farm Security Administration), created 1937 to aid tenant farmers, and to carry on the resettlement and rehabilitation work of the Resettlement Administration. Division of the Department of Agriculture.

FSA (Federal Security Agency), created 1939 to direct all agencies concerned with social and economic security, educational opportunity, and national health; includes Office of Education, Public Health Service, U. S. Employment Service, Food and Drug Administration, SSB, and NYA.

FSCC (Federal Surplus Commodities Corporation), created 1935 to distribute surplus farm products to state relief agencies for the use of the needy. In 1942 it became part of the Agricultural Marketing Administration.

FWA (Federal Works Agency), created 1939 to coördinate all public construction.

HOLC (Home Owners' Loan Corporation), created 1933 to grant long-term mortgage loans to save homes from foreclosure. Division of the National Housing Agency.

MLB (Maritime Labor Board), created 1938 to improve labor relations among seamen. Expired in 1942.

NEC (National Emergency Council), created 1933 to coördinate and make more efficient the work of the federal agencies. Abolished 1939 and functions transferred to Executive Office of the President.

NHA (National Housing Agency), created 1942 to consolidate all housing activities. Includes Federal Housing Administration, Federal Home Loan Bank Administration, Federal Public Housing Authority.

NLRB (National Labor Relations Board), created 1935 to protect employees in their rights to self-organization and collective bargaining.

NRA (National Recovery Administration), created 1933 to draw up trade codes of fair competition; declared unconstitutional 1935.

NRPB (National Resources Planning Board), created 1939 to advise president on development of national resources; coöperated with state and regional planning boards. Abolished 1943.

NYA (National Youth Administration), created 1935 to furnish part-time employment for needy high-school and college students; to provide part-time employment on work projects for out-of-school youth; to provide vocational guidance. Transferred to Federal Security Agency 1939, and abolished 1943.

PWA (Federal Emergency Administration of Public Works, better known as Public Works Administration), created 1933 to reduce unemployment and restore purchasing power through construction and long-range planning of public works. Abolished 1943.

RA (Resettlement Administration), created 1935 to administer rehabilitation and resettlement projects for the relief of farm areas. Abolished in 1937, and program completed by FSA.

REA (Rural Electrification Administration), created 1935 to introduce electric service into rural areas not now served. In the Department of Agriculture.

SEC (Securities and Exchange Commission), created 1934 to license and regulate stock exchanges and to control public utility holding companies.

SMA (Surplus Marketing Administration), created 1940 by merging the FSCC and the Division of Marketing and Marketing Agreements of the AAA. In 1942 merged in the Agricultural Marketing Administration.

SSB (Social Security Board), created 1935 to administer the federal old-age retirement funds, and to study and recommend methods of providing economic security through social insurance. In Federal Security Agency.

TVA (Tennessee Valley Authority), created 1933 to operate government-owned properties at Muscle Shoals, Ala.; to develop water and power resources of the Tennessee River watershed; and to plan for the social and economic well-being of the valley.

USMC (United States Maritime Commission), created 1936 to develop a merchant marine to carry the domestic and foreign water-borne commerce of the United States, on ships constructed, owned, and operated by citizens of the United States; succeeded the United States Shipping Board and Merchant Fleet Corporation.

WPA (Work Projects Administration), created 1935 to relieve unemployment through useful work projects. Division of Federal Works Agency. Abolished 1942.

The "New Deal for Labor," in addition to other provisions in the codes for industries, included a notable "Section 7a" of the enabling act, which provided that in all codes "employees shall have the right to organize and bargain collectively through representatives of their own choosing." This provision led later to much bitter controversy, with labor unions demanding the right to speak for employees, and many industries and companies holding out for the "company union," formed within a single company to represent the employees. A National Labor Board (NLB) was created to deal with such controversies, and other boards were created for specific industries, as well as regional boards.

Vexing Problems of Currency and Finance

In its dealings with currency and public finance, the Roosevelt administration faced a double problem. In addition to meeting the ordinary expenses of government, it had to provide vast sums for financing the New Deal—sums much too great to be raised by taxation. The other side of the problem was the fact that whatever the government did to finance its activities would have profound effects upon business and finance in general. The problem was further complicated by a widespread feeling that "money was too dear," and that this condition should be remedied by "inflating the currency."

In export trade, the inflationists argued, the United States was at a heavy disadvantage, trying to sell goods for dollars at their full gold value, when most of the competing nations were asking payment in "devalued" currency, and most consuming nations also had "cheapened" their currency or abandoned the gold standard entirely. By doing the same, the United States would lower the value of the dollar sufficiently to revive export trade, according to this view. At the same time, making the dollar worth less would, it was argued, help debtors pay their debts, since it would tend to raise prices to somewhere near the level at which they stood when the debts were incurred. The inflationist group in Congress proved strong enough to secure legislation empowering the president at his discretion to cut the amount of gold represented by a dollar by as much as 50 per cent, to issue "fiat" money, and to use silver as a base for money (*see* Money).

Most economists and business leaders argued that such measures always led eventually to general economic ruin. They believed that the United States could work itself out of the depression more quickly and more surely by clinging to "honest money." Meanwhile, the government already had suspended the gold standard, as part of President Roosevelt's program for dealing with the banking crisis.

In his attack upon these problems, President Roosevelt started by slashing the expenses of ordinary government 25 per cent, under authority given him by Congress to reduce salaries, veterans' benefits, and other expenses. "New Deal" expenditures were provided for in an "extraordinary budget," with money supplied partly by new taxation, but in greater part borrowed from banks and other financial institutions. Congress, however, undid many of these economies, over the President's veto; and expenditures under the extraordinary budget grew by staggering leaps to a new peace-time high.

The "Managed Currency" Policy

While this situation was developing, President Roosevelt was dealing with the related currency problem in a fashion that puzzled conservatives and inflationists alike. Early in his term he obtained authority from Congress under which he required all owners of gold and gold certificates to turn their holdings in to the government, under heavy penalties, and be given "lawful money"—that is, government paper—in return. The dollar, no longer redeemable in gold, sank steadily in relation to foreign currencies; and the administration began driving it down further by purchasing gold at about $35 an ounce. Since the old price had been $20.67 an ounce, nearly twice the number of dollars now was being given for gold—and thereby each dollar became worth correspondingly less in terms of gold. Early in 1934 the President "pegged" the dollar, on a "managed currency" basis. Under this plan, no gold could be used as money in the United States, regardless of existing contracts calling for gold payment. For settling transactions abroad, gold could be obtained in bars from the government, on the basis of $35 an ounce. The President also announced that, under the powers given him by Congress, he might increase or decrease the amount of gold given for a dollar, at any time such action might seem desirable. This was the "management" feature of the money policy.

This policy was denounced by conservatives, many of them within the President's own party. Al Smith spoke of "baloney dollars," and Senator Glass of Virginia denounced these measures as "national repudiation" and "dishonorable." But the inflationists, while partially satisfied, felt that President Roosevelt was not going far enough. He did nothing toward issuing fiat money; and his concessions to the advocates of silver were meager. A law passed in 1934 declared that the United States "eventually" would maintain one-quarter of its reserve behind paper money in silver, and the Treasury purchased silver at an advance upon existing market prices; but these steps fell far short of the demands of the extreme inflationists.

Reception of the New Deal

The New Deal program at first met with widespread popular approval. Many people enthusiastically believed that it would soon solve the nation's troubles. Even those who were inclined to doubt the wisdom of this or that feature of the program were, for the most part, willing to give the President's plans a fair trial.

Better banking conditions and the renewed spirit of optimism brought about what appeared to be a real revival of business. Prices of many things rose

rapidly, manufacturing began to pick up, unemployment decreased, and stocks and bonds went up, while many businesses began to show profits again. Progress, however, was irregular; the "durable goods" industries in particular showed scarcely any improvement. The winters of 1933–34 and 1934–35 were hard financially and would have witnessed greater distress than ever before had it not been for huge government expenditures for relief.

Increase in Labor Troubles

In 1934, when industry appeared to be recovering in some measure, labor troubles became more frequent. Such troubles always had arisen during past depressions, whenever recovery seemed under way, as the result of the desire of labor to secure a larger share of the increased income flowing into businesses; but this time the situation was complicated by the government guarantee of the right to collective bargaining. Many unions saw this guarantee as an opportunity to win recognition from industries which previously had been "open shop." A strike of marine workers in San Francisco during the spring of 1934 involved the entire community in a general strike for a few days, and the trouble threatened to spread throughout the Pacific Coast; but public disapproval soon forced a compromise of the issues involved. After a widespread textile strike in the late summer of 1934, the President called upon labor and industry alike for a "six months' truce" and a fair trial of government mediation.

Enforcement of codes by the NRA caused constant, and often bitter, differences of opinion concerning the wisdom of various measures included in the codes. Many smaller business enterprises complained that provisions intended to end cut-throat competition and ruinous price-cutting really were robbing the smaller enterprises of all benefit from their ability to operate at lower costs. Such a result, they asserted, was rapidly placing the large companies in complete control of business. After a period of trial, the NRA gave up the attempt to regulate small "service businesses" such as dry-cleaning and beauty shops. Some business leaders felt that NRA had values which should be permanently retained; and the public generally approved of such changes as a shorter working week and abolition of child labor. The course of prices also caused a division of opinion. Many consumers complained that prices were getting too high, while many businesses felt that prices were not rising fast enough to a satisfactory level.

The program for agricultural recovery produced similar mixed results. The prices of many farm products went up markedly; but prices of manufactured goods also rose, though not to an equal extent. The problem, as seen in the Middle West and plains states, was changed materially in 1934 by one of the most disastrous droughts in United States history. Instead of having to deal with an overproduction problem, the government found itself required to expend vast sums in drought relief. Southern farmers generally were satisfied with the government's program, since prices had improved materially for such southern crops as cotton and tobacco.

Foreign Relations and Tariffs

In foreign affairs, President Roosevelt declared a "good neighbor" policy, and pledged himself not to intervene by force in the affairs of other nations. Soviet Russia was recognized late in 1933; but no considerable trade advantages were realized. In 1934 the administration withdrew the marines from Haiti and renounced the Platt Amendment, which gave the United States the right to intervene in Cuba; in 1935 it renounced a similar right in Panama. The President favored the limitation of navies by international agreement, but, pending the negotiation of a new treaty to take the place of the Washington Naval Treaty which lapsed in 1936, he sought to build the United States navy to full treaty strength (*see* Navy).

The war debts question was brought to a head by passage of the Johnson Act on Apr. 13, 1934. This law forbade any person or organization in the United States, except government agencies, to buy or sell the securities of nations in default. The total amount of the funded war debt owed by European nations to the United States was then about 12 billion dollars. Up to that time Great Britain, Czechoslovakia, Italy, Latvia, and Lithuania had been making small token payments. As a result of the Johnson Act these nations joined others in defaulting completely. Only Finland continued to pay. (*See* World War.)

The Reciprocal Tariff Act of June 16, 1934, authorized the President to lower import duties by 50 per cent in negotiating trade treaties with other nations (*see* Tariff).

A noteworthy event was passage of the 21st amendment, which repealed the 18th (Prohibition) amendment. The amendment was ratified by the necessary 36th state on Dec. 5, 1933. Congress had previously repealed the Volstead Act and legalized beer.

Political Truce Ends

In the Congressional elections of 1934, the Democrats were overwhelmingly triumphant. They won 322 of the 435 seats in the House, and 69 of the 96 senators were Democrats. With the election over, however, there were signs of a change of feeling. Up to this time the spirit of "support the President" had been general. Now people began to feel that the worst of the crisis was over, and that the time had come to judge policies for their permanent value in promoting the general welfare.

The Republicans and many conservative Democrats demanded a return to the traditional American policy of maintaining free economic competition, with a minimum of government control. But the President and his advisers held that in the complex life of today free competition could lead only to the alternation of booms with depressions, and that industry must be regulated to curb abuses.

An additional complication was created by the top-heavy Democratic majority in Congress. Many

Democrats in Congress favored far more radical changes than the President wanted; and they felt free to rebel against the party program, since they could do so without destroying the Democratic majority. Democratic conservatives similarly felt free to break with the President's policies.

The Financial and Relief Program of 1935

As soon as the new Congress met, the President asked 4 billion dollars for public works designed to give "work relief," and 880 million dollars to continue "direct relief" temporarily. These and other expenditures would total more than 8½ billion dollars for the fiscal year ending June 30, 1936—about 4½ billion dollars over the estimated revenue. Borrowing to meet the deficit would bring the public debt to about 34¼ billion dollars.

Various groups attempted to modify this program. Organized labor fought to compel payment of "prevailing wages" on work relief projects. The Patman Bill calling for payment of the soldiers' bonus was passed, but vetoed. Various "silver bills" passed in the House or the Senate were killed in conference.

The economy measures of 1933 were invalidated by bills restoring government pay cuts and all pensions in effect on March 19, 1933. The President recommended sharply increased taxes on incomes, estates, inheritances, and gifts. This was popularly called the "soak the rich" program. After long debate Congress passed the measure, with slight changes.

Important Supreme Court Decisions

Serious problems were created by Supreme Court decisions pronouncing various New Deal measures unconstitutional. Repudiation of the "gold clause" in government bonds was held invalid; but Congress took advantage of one feature in the decision to pass a law directing the Court of Claims not to entertain gold clause suits. Another decision overthrew the government's attempt to prohibit interstate transportation of petroleum produced contrary to regulations. The Railroad Retirement Act, setting up government-administered pensions for railroad employees, and the Frazier-Lemke Act, granting farm mortgage relief, were also declared invalid. The most staggering blow came in a decision, on May 27, pronouncing the NIRA unconstitutional, because it delegated to the executive powers which only Congress could exercise.

The administration sought to save various NRA features by the Guffey-Snyder Act creating a Coal Commission to regulate the bituminous coal industry, and the Wagner-Connery Labor Relations Act, which guaranteed collective bargaining to employees and set up a National Labor Relations Board.

Social Security, Utility, and Banking Acts

Almost from the beginning of his term, President Roosevelt had urged "social security" laws providing federal coöperation with the states in providing unemployment, old-age, and other relief. This legislation was passed by votes of over 90 per cent of each house in Congress (*see* Social Insurance). A new Banking Act, enacted after vigorous opposition and prolonged debate, increased the Federal Reserve System's powers (*see* Federal Reserve System). The Utilities Holding Company Act limited holding companies, which through stock ownership controlled great interstate combinations of electric power and gas operating companies in interstate operations.

This first session of the 74th Congress had been one of the longest on record—234 days. It closed August 26 with a filibuster by Senator Huey Long of Louisiana which prevented passage of a third Deficiency Bill, voting funds for social security and other purposes. Senator Long (who was assassinated a few weeks later) was trying to force passage of a pet measure by talking until the Senate met his wishes.

A neutrality resolution directed the President to lay an embargo upon exports of arms and munitions to nations at war, and forbade American ships to carry such materials to neutral ports. The President issued such a proclamation when war broke out between Italy and Ethiopia.

Events and Issues of the Election Year

On Jan. 7, 1936, the Supreme Court held the AAA unconstitutional, on the ground that Congress had no power to regulate agricultural production. The Guffey-Snyder Act was held invalid on May 18 for similar lack of power. On June 2 the Supreme Court ruled that New York State could not fix minimum wages for women, since this would violate freedom of contract. These decisions emphasized the fact that the President, if reëlected, would have to abandon much of his program, or seek amendments to the constitution.

Early in 1936, Congress overrode a presidential veto and ordered the veterans' bonus paid. The AAA decision was met with a law which provided bonuses for farmers who agreed to follow the government program for soil conservation. A Commodity Exchange Commission was created with broad powers to regulate trading and practises on grain and other commodity exchanges. Another law limited the award of government contracts involving over $10,000 to bidders who maintained working standards equivalent to those under the NRA. The Robinson-Patman Act, aimed at chain stores, gave the Federal Trade Commission power to regulate the discounts granted to purchasers of goods in large quantities. The session closed on June 21, ten days after the Republicans had nominated Alfred M. Landon, governor of Kansas, for the presidency, and five days before President Roosevelt was renominated by the Democratic party.

The ensuing campaign naturally turned upon public opinion concerning New Deal policies, particularly those which were believed to involve fundamental principles of American government.

The Republican Campaign

The Republican party urged that the people repudiate what it called an obvious attempt to replace traditional American freedom of action with "regimentation," or detailed governmental control of finance, business, and agriculture through such agencies as the NRA and the AAA. The growth in government expend-

itures and the national debt was violently condemned, particularly for the expenses incurred by the Works Progress Administration (WPA). This had been organized May 6, 1935, under Harry L. Hopkins, to pay a small wage for "made work" to about three million unemployed persons.

To these objections, President Roosevelt replied that recovery had come, and his administration's measures had brought it. He reaffirmed his intention to press on with more reforms until American life had been made satisfactory for the common people.

A Smashing Victory

In 1932 many Republican voters had supported Roosevelt; in 1936 many conservative Democrats supported Governor Landon. Among them were John W. Davis and Alfred E. Smith, the Democratic candidates for president in 1924 and 1928. About three-fourths of the nation's newspapers opposed the President's re-election.

The people, however, gave Roosevelt the most overwhelming victory since James Monroe's election in 1820. Landon got only 8 electoral votes, from Maine and Vermont. Roosevelt got 523 electoral votes, 98.5 per cent of the total, from the other 46 states. He won more than 27,770,000 popular votes; Landon received about 16,680,000. The Democrats won 334 of the 435 seats in the House, and now held 75 of the 96 seats in the Senate.

SIGNING THE SOCIAL SECURITY BILL

President Franklin D. Roosevelt is shown here immediately after he signed the Social Security Bill, one of the most significant measures of his first administration. Behind him stand Senator Robert F. Wagner (left) of New York, Frances Perkins, secretary of labor, the first woman to hold a Cabinet position in the United States, and Senator Pat Harrison of Mississippi, all active leaders in behalf of the President's social security policies.

At this time business conditions were improving rapidly, and hostile business leaders resigned themselves to New Deal policies. Knowledge that corporation savings would be taxed heavily caused an outpouring of dividends, bonuses, and wage increases.

On December 1, the President opened the Inter-American Conference for Maintenance of Peace, at Buenos Aires. His statement that aggressors would find "a hemisphere wholly prepared to consult together for our mutual good" was hailed as a new Pan-American Monroe Doctrine.

Start of the Second Administration

On Jan. 20, 1937, President Roosevelt was inaugurated for a second term. He dedicated his second administration to winning "a greater satisfaction in life for the common man." Before this, the 75th Congress had renewed the life of the RFC and related loan organizations. But this smooth start was followed by bitter dissension in Congress and in the country.

In plants all over the country, a wave of "sit-down" strikes afflicted industry. Strikers occupied the shops and even the offices. Most of these strikes grew out of efforts by the Committee for Industrial Organization (C.I.O.), headed by John L. Lewis, to establish industrial or vertical unions in such mass-production industries as rubber, steel, and automobile manufacture (*see* Labor Parties). The wave of strikes receded rapidly after the failure of bitterly fought conflicts to unionize the smaller steel companies.

Trouble with Japan

Foreign affairs became increasingly troublesome after war broke out between Japan and China in July. On October 5 the President said in Chicago that aggressor nations should be quarantined. Serious trouble threatened when, on December 12, Japanese aviators bombed and sank the American gunboat *Panay* near Nanking. Japan's prompt apology and payment of damages settled this issue.

The Supreme Court

The chief issue in 1937, however, proved to be the President's plan for reorganizing the Supreme Court. In February he asked for power to name a new justice to sit and vote with any justice who did not resign when 70 years old. At the time, this would permit the President to appoint six justices, who presumably could be expected to give favorable decisions on New Deal laws.

This proposal was opposed as an attempt to "pack" the Court. Opposition increased after March 29, when the Court, by 5 to 4 decisions, upheld the constitutionality of the Wagner-Connery Labor Relations Act and of a minimum-wage law of the state of Washington. In June Justice Van Devanter retired, making possible the appointment of a liberal; and on July 22 the Senate rejected the President's plan. The Senate then confirmed the President's appointment of Sen-

ator Hugo Black of Alabama to the Court. Senator Black took his seat in spite of protests based on the fact that a life membership in the Ku Klux Klan had been issued to him in 1926.

Business Depression and New Laws

Meanwhile a sudden decline in business was creating alarm. Throughout 1936 prices and production had risen in expectation of strong buying both by consumers and for European rearmament. But the production was not absorbed, and early in 1937 prices started to fall. After midsummer, business slackened, unemployment increased, and security prices collapsed.

To meet this situation, the President called Congress into special session in November, and proposed a bill to finance home building, a crop-control bill, and a bill regulating wages and hours. Early in the regular session of 1938, Congress passed the first two of these measures.

The Steagall Housing Act was devised to attract capital into building and improving small homes, by providing a government guarantee of mortgages made to finance such work. The new Agricultural Adjustment Act continued soil-conservation payments and set up a system of crop control. In years of abundant production, producers would be asked to vote upon control. If two-thirds of the votes were favorable, individual producers would be limited in their sales during the crop year, subject to heavy penalties. Any surplus could be stored as security for a loan.

Conservative Democrats Revolt

On two important issues, however, conservative Democrats deserted the President and joined the Republicans to defeat his wishes. Throughout 1937 business had complained about the "undivided surplus" tax. This tax had been laid in 1936 upon income held as surplus. Its purpose was to force this income out as dividends, which would be subject to income tax. Businessmen said this tax penalized "saving against a rainy day," and prevented financing expansions out of earnings. Congress sided with them by passing a tax law which retained only a vestige of the undivided surplus tax. The President allowed this measure to take effect without his signature on May 28.

The conservative Democrats joined the Republicans again to defeat the President's measure—called the "dictator bill" by its opponents—giving him power to reorganize executive departments of the government.

But Congress welcomed the President's proposal made on April 14 for new government spending, and appropriated nearly 3 billion dollars for relief and public works. Congress also passed the Vinson Naval Expansion Act to increase the navy by 20 per cent.

Altogether the second session of the 75th Congress appropriated more than 11 billion, 300 million dollars, a peacetime record. As a result, Congress was told in January 1938 that the public debt in bonds and borrowings from banks was within 5 billion dollars of the limit of 45 billions which had been set in 1935.

Congress again supported the President when it passed the Fair Labor Standards Act. This act, approved on June 25, 1938, required that all workers producing goods in interstate commerce should be paid at least 25 cents an hour, and time and a half for more than 44 hours a week. A year later, the minimum wage was to be 30 cents, with a maximum working week at normal pay of 42 hours. In the third year the figures were to be 40 cents and 40 hours.

Executive, professional, farm, and transportation workers, and those engaged in processing perishable foodstuffs, were exempted from these minimums. The enforcement of the law was entrusted to an administrator, appointed by the President. The administrator appoints industry committees to advise concerning enforcement and to recommend exemptions when enforcement would result in substantial unemployment.

The Fall Elections of 1938

During the summer the President widened the split in his party by urging that several senators who had opposed his policies be defeated in the primaries. The opposition called this a "purge." Every senator opposed by the President won renomination.

The elections on November 8 also reflected a trend toward conservatism. The New Deal Democrats retained control of Congress; but they suffered their first severe losses at the polls. The Republicans gained 8 seats in the Senate, 80 seats in the House, and elected 18 state governors in place of five.

The 76th Congress Strengthens National Defense

The legislation enacted by the first session of the 76th Congress, in 1939, centered around national defense, relief, and social security. The final weeks of the session were marked by a series of defeats for measures proposed by the administration. Appropriations totaled more than 13 billion dollars.

Growing tension in Europe and the race for rearmament led Congress to make national defense its first concern. The armament-limitation program pursued after the World War was abandoned; and nearly 2 billion dollars was voted for defense. A series of acts was passed to increase the armed forces, to strengthen strategic defense positions, and to build up stocks of essential war materials.

Unemployment, Relief Measures, Labor

The most troublesome domestic problem continued to be unemployment. Despite the considerable progress that had been made toward business and industrial recovery, there were still, at the lowest estimate, more than 8 million potential workers without jobs. Among the many factors which contributed to this situation, three were conspicuous: the failure of industries to expand at the previous rate; increasing replacement of men by machines (*see* Industrial Revolution); and increase of population. Some 6 million more persons, it was estimated, were available for jobs in 1940 than in 1930.

In the early years of the New Deal it was believed that the problem could be solved by temporary measures. But when the situation failed to improve after a number of relief devices had been tried, New Deal leaders came to regard unemployment as a lasting

ONE OF THE MANY FEDERAL HOUSING PROJECTS

To provide healthful dwelling places for people with small incomes, the Public Works Administration and the United States Housing Authority have helped to build in many cities groups of apartments like this Cedar-Central Project in Cleveland. To make room for this project, which provides 650 dwelling units, an 18-acre tract occupied by slums was cleared with WPA labor.

problem requiring permanent federal bureaus and annual appropriations. In 4½ years, during the period 1935–39, the Federal government spent nearly 11½ billion dollars for emergency relief, most of it to supply work through the Work Projects (formerly Works Progress) Administration. The 76th Congress met the President's demands for relief appropriations for 1940 but placed various restrictions on the WPA.

Further Aid for Agriculture

A serious decline in farm income in 1939 caused dissatisfaction with the Agricultural Adjustment Act of 1938, but no general revision was attempted. Congress, however, appropriated more than one billion dollars for agriculture. This sum, federal farm officials said, would make possible the most extensive system of agricultural aid since 1933 (*see* Agriculture).

Arrangements were made for distributing surplus commodities to city persons on relief. Because of the huge amount of cotton in storage, a subsidy of 1.5 cents a pound was granted to exporters of raw cotton. A rapid reduction in the carry-over brought it down to 20 cents a hundred pounds by the end of 1939. A cotton-rubber barter treaty with Great Britain was signed in June. Crop insurance, provided for wheat in the 1938 AAA, was extended to cotton.

Other Measures Adopted

Amendments to the Social Security Law provided for liberalized benefits and for beginning old-age payments in 1940 instead of in 1942; and "froze" the insurance tax to be paid by employers and employees at one per cent for 1940–42 (*see* Social Insurance).

The President's monetary powers and the 2-billion-dollar stabilization fund were continued to Jan. 15, 1941. After two years of bitter controversy, Congress also gave the President authority to reorganize the executive departments of the government, subject to disapproval by Congress within 60 days. His first two plans were approved and put into effect July 1, 1939, and three others were adopted in 1940 (*see* United States Government).

An important piece of legislation bearing on the 1940 presidential campaign was the Hatch Act. This measure, ruling against "pernicious political activities," was designed to take politics out of relief and out of the federal service generally.

Supreme Court Appointments

In 1940 the President appointed Attorney General Frank Murphy to the Supreme Court to succeed the late Justice Pierce Butler. This brought the number of his appointees to five, constituting a majority of the court. Besides Justice Black, previously mentioned, and Justice Murphy, his appointees were Justices Stanley Reed, Felix Frankfurter, and William O. Douglas. They succeeded Justices George Sutherland and Louis D. Brandeis, who retired, and Justice Benjamin Cardozo, who died.

Growing Concern over Foreign Affairs

Through the spring and summer of 1939, as the situation in Europe became more menacing, foreign affairs overshadowed domestic issues. From the beginning of his administration, the President had been outspoken against the aggressive policies of Germany and Italy. Resentment against Japan also had been growing, because of its continued disregard for American rights in China. Repeated protests from the United States were ineffective, and in July more vigorous action was taken. The State Department denounced (effective in six months) the 1911 treaty regulating trade with Japan.

Neutrality and Peace Measures

When the European war broke out in September, the President's first concern was to preserve United States neutrality, to strengthen defenses, and to protect the country against economic shock. On September 8 he issued a proclamation declaring the nation's neutrality and reserving all its rights under international law. Then, urging the revision of the provisions of the Neutrality Act of 1937 which handicapped the Allies by forbidding the export of certain war materials, he called a special session of Congress for September 21. After vigorous debate, Congress passed a revised act on November 3 (*see* Neutrality Policy of the United States).

In furtherance of the policy "to keep war from coming to the Americas," delegates from the United

States joined a Pan American conference at Panama on September 23. The American nations announced the establishment of a "safety belt" averaging 300 miles in width around the Americas as far north as Canada and made plans for patrolling this area. In December President Roosevelt appointed Myron C. Taylor as his personal representative with the rank of ambassador to the Vatican to coöperate with papal peace efforts.

A large number of agents were added to the Federal Bureau of Investigation to aid in dealing with espionage, propaganda, and possible sabotage. The Dies Committee, a House committee created in 1938 under the chairmanship of Martin C. Dies of Texas to investigate subversive and un-American propaganda and activities, reported after a year and a half of work that the nation was in no present danger.

The Treasury Department, the Federal Reserve Board, and the Securities and Exchange Commission had for months been making arrangements to cushion the stock market against a shock like that of 1914, when the stock exchange was forced to close. Another stabilizing factor was that foreign nations had control over American securities held by their citizens and over buying from abroad.

Issues Before the 76th Congress

When Congress again convened on Jan. 3, 1940, foreign policy was considered settled, and attention centered upon the budget and the administration's demand for extension of the Reciprocal Trade Agreements Act of 1934. The budget was a major problem because of the huge deficit, which had been increasing for 11 years and had by 1940 brought the national debt within 3 billions of the 45-billion-dollar limit set by statute. With some 20 of Secretary Cordell Hull's trade treaties in effect, a number of groups representing special interests strongly opposed the continuance of this program, claiming that it was injurious to domestic agriculture and industry.

Another problem was the disposal of increasing surpluses of agricultural products. One measure taken by the Department of Agriculture was enlargement of its "food stamp" plan, by which persons on relief could buy so-called "surplus" foods at reduced prices. (*See also* Agriculture.)

Measures for Hemisphere Defense

Germany's astounding victories in the spring and summer of 1940 caused the administration to speed its program for defense of the Western Hemisphere. In July the United States joined the other American republics in a conference in Havana. The result was the Act of Havana, an agreement that the western nations would act as trustees to hold American colonies of any European nation against seizure by any other non-American power (*see also* Latin America).

On August 18 the President and Premier Mackenzie King of Canada announced that they would form a joint board to consider problems of common defense. The American board, named on August 22, was headed by Mayor Fiorello La Guardia of New York City.

On July 25 the President announced a virtual embargo upon export of aviation gasoline except to Great Britain and countries in the Western Hemisphere. Later he placed restrictions, to become effective October 16, upon exports of the most desirable grade of scrap iron. These acts were interpreted as a strong hint to Japan that the United States would exert economic pressure to curb Far Eastern aggression.

During the summer, Great Britain's stubborn resistance in the face of German air attacks swung the American people to the policy of giving the British all possible aid short of war. One result was the epochal announcement on September 3 that Great Britain had agreed to give the United States 99-year leases upon sites for air and naval bases in the Americas, in exchange for 50 overage destroyers. Germany, Italy, and Japan met this agreement by announcing on September 27 that they had formed an alliance against all future enemies.

The Program to Strengthen American Defense

During these months the nation had been carrying forward the largest armament program in its history. When the administration decided that the country's new responsibility for hemisphere defense required a standing army of 1,200,000 men and 800,000 trained reserves, Army officials said that such numbers could not be obtained quickly enough through voluntary enlistments. Congress then faced the prospect, for the first time in American history, of conscripting men in peacetime for military service. After long debate, conscription was approved by a vote of 45 to 27 in the Senate and 232 to 124 in the House. The President signed the bill Sept. 16, 1940.

Under this law, all men between the ages of 21 and 36 registered with local boards on October 16. They were liable for one year of training, and service for 10 years or until 45 years old, in the reserve. The order of call for service was determined by lot, and the men were to be classified, in effect, in two groups: (1) those physically, mentally, and otherwise available for immediate service; and (2) those whose service was to be deferred because they would serve the nation's interests better by remaining at their usual work, or for other reasons.

The Army's plan was to use the men called up for enlarging the organizations of the Regular Army and the National Guard to a total of 45 divisions. A bill approved on August 27 authorized the President to call the Guard for a year's training, and this force was called as training facilities were completed.

The total number registered was nearly 17 million. Lack of cantonments, clothing, and other items limited the numbers called for training to 30,000 on November 18; 60,000 on December 2; and 710,000 in 1941. (*See also* Army; Navy.)

Presidential Campaign of 1940

National defense was the keynote of the 1940 presidential campaign. The campaign was touched off on June 20 by President Roosevelt's nomination of two Republicans, Henry L. Stimson of New York and

Frank Knox of Chicago, as secretaries of war and of the navy. This was done, he said, in a nonpartisan effort to obtain the best-qualified men for the posts; but the Republicans charged that it was an effort to confuse and disrupt their party.

The Republican convention, held in Philadelphia June 24–28, nominated Wendell L. Willkie of New York City. The Democratic convention, held in Chicago July 15–19, nominated President Roosevelt for a third term.

From the beginning the campaign was exceedingly bitter. The Republicans contended that President Roosevelt's re-election, in violation of the long-standing tradition against a third term, would be a dangerous innovation in critical times. The Democrats argued that the crisis abroad made it necessary to retain a chief executive who was thoroughly experienced in world affairs. On the supremely important issues of foreign policy and national defense, however, both candidates were in substantial agreement. Willkie supported the administration's program of aid to Britain and he urged the adoption of conscription and other measures of rearmament.

On November 5 the people re-elected President Roosevelt, with Henry A. Wallace as vice-president, by a total vote of about 27,000,000 to 22,000,000. The Congressional elections produced a Senate of 66 Democrats, 28 Republicans, and two others. The new House was composed of 267 Democrats, 162 Republicans, and six others. With the end of the campaign, partisan politics were quickly abandoned. The defeated Republican presidential candidate led the way by urging his followers to join him in supporting the President through the critical times ahead.

Administration of the Defense Program

To coördinate the vast program of arms production, the President in 1940 had appointed seven members to a National Defense Advisory Commission. The functions of this body were largely taken over by the Office of Production Management (OPM), created Jan. 7, 1941. William S. Knudsen was director general and Sidney Hillman associate director, with the secretaries of war and of the navy acting in an advisory capacity. The work of the OPM was carried out through the divisions of labor, production, purchases, and priorities. The President exercised authority over these and other new defense agencies through the Office for Emergency Management.

Action was required on certain immediate problems. There was, first, the problem of expanding industrial facilities. Public funds were provided for some new plants, which were then owned by the government but operated by private companies. A second hazard—inflation—was dealt with by the division of price stabilization, headed by Leon Henderson, which sought to peg the prices of basic commodities.

A third problem arose from the increase of strikes, declared mostly by the C.I.O., which was carrying on an organizational drive in national defense industries. On March 19 the President created the National Defense Mediation Board, with representatives of organized labor, the employers, and the public among its 11 members. The board was empowered to mediate disputes which the Labor Department could not settle. But when the board failed to avert a strike at North American Aviation, Inc., near Los Angeles, the Army, under presidential order, on June 9 took over the plant and operated it until the workers returned.

"Lend-Lease" Aid to Britain

Meanwhile the administration was steadily pushing ahead its program to make the United States the "arsenal of democracy." When Great Britain warned that it would soon be unable to pay cash for war materials, the President asked Congress for authority to lease or lend arms and supplies to "countries whose defense the President deems vital to the defense of the United States." The President also was to have authority to set the terms of transfer, but he was required to report to Congress not less frequently than once every 90 days on his operations under the act. After heated debate, Congress granted these powers in a bill which the President signed March 11. The first appropriation under the Lend-Lease Act was 7 billion dollars.

The defense program by this time called for expenditures of approximately 40 billion dollars—or $310 for every person in the United States. On February 19 the national debt limit had been increased to 65 billion dollars, and it was believed that it would be necessary to raise it still more.

The high rate at which the Germans were sinking British shipping in the Atlantic soon brought up the question of convoys. The President announced his determination to take any measures necessary to insure the delivery of supplies to Britain. The "isolationists," whose spokesmen were Senator Wheeler of Montana and Charles A. Lindbergh, vigorously opposed any naval escort for American supplies.

Declaration of "Unlimited Emergency"

To deal with the crisis, the President on May 27 proclaimed the existence of an "unlimited national emergency." Under Congressional enactments dating chiefly from the World War of 1914–1918, he thereby assumed many broad powers.

Another domestic development was President Roosevelt's nomination on June 12 of Justice Harlan F. Stone to succeed Charles Evans Hughes as chief justice of the Supreme Court, and of Attorney General Robert Jackson and Senator James F. Byrnes as associate justices. Of the nine justices, Roosevelt had now appointed seven—a record exceeded only by President Washington.

Measures against the Axis

Germany's invasion of Soviet Russia on June 22 was condemned by the United States as a "treacherous attack." The President said the government would lend material assistance to Russia or any other country which resisted German aggression.

When Japan wrested military control of Indo-China from France and thus indicated an intensified program of aggression in the Far East, the United States took prompt action. On July 25 it "froze," or prevented the removal of, Japanese assets in the United States, and so opened the way for cutting off trade with Japan. It also brushed aside protests against shipping war material to Russia through waters bordering Japan.

To take stock of their war efforts and aims, President Roosevelt and Prime Minister Churchill of Great Britain met in August on the sea off the North American coast, along with high officials of both governments. Their conferences resulted in an eight-point declaration of the broad peace objectives of the two democracies. Another result was the sending of a joint British and American mission to Moscow to speed plans for aid to the Soviet Union.

Progress of Rearmament

Expansion of the armed forces of the nation had become sufficiently advanced by this time to permit a long-term evaluation. On the recommendation of Army officials, the Selective Service Act was amended on August 18 to extend the service of selectees and national guardsmen to two and a half years, and to remove the limitations on the number of men trained. Meanwhile Navy officials estimated that the current rate of construction would complete by 1946 a two-ocean navy strong enough to meet simultaneously all enemies in the Atlantic and Pacific oceans.

The rearmament program began to hit the average citizen in the summer of 1941. On September 20 the highest taxes in the nation's history became law. The program of the administration was designed to raise about 3½ billion dollars a year by taxes upon all personal incomes except the smallest, heavier taxes on the profits of corporations, and new taxes on many kinds of goods and services. Priority in obtaining raw materials and machinery was given to producers of military equipment, and producers of civilian goods took what was left. This brought curtailment in the manufacture and supply of many commodities, from automobiles to razor blades. On August 28 the President created a Supply Priorities and Allocations Board, headed by Donald M. Nelson, to apportion strategic materials according to need.

Throughout the spring and summer there were mounting signs of an impending naval clash between Axis and American forces. On April 9 the United States, in defiance of German-occupied Denmark, took Greenland under its protection, and on July 7 landed forces in Iceland.

Naval Clashes with Germany

Germany met these moves by bolder action against American ships. On May 21 the American freighter *Robin Moor* was sunk by a German submarine in the Atlantic. On September 4 the American destroyer *Greer* was attacked by a submarine near Iceland.

On September 11 the President ordered the Navy to destroy Axis raiders found in American waters; and the United States undertook to convoy, as far as Iceland, ships carrying supplies to England. On October 31 the American destroyer *Reuben James* was torpedoed and sunk while on convoy duty to Iceland. The Nazi government officially charged that "American destroyers had attacked German submarines and that therefore the United States had attacked Germany." On November 17 the Neutrality Act was amended to permit arming American merchant ships and to let them enter belligerent ports.

Japan Attacks the United States

Meanwhile the administration was conferring with Japan with a view to establishing peace in the Pacific. While negotiations were in progress, Japan early Sunday morning, December 7, struck without warning. Bombers attacked Hawaii, the Philippines, and other American outposts in the Pacific. Then Japan declared war on both the United States and Great Britain.

At noon on the following day, December 8, President Roosevelt addressed a joint session of Congress. He asked Congress to declare that "since the unprovoked and dastardly attack by Japan a state of war has existed between the United States and the Japanese Empire." With only one dissenting vote, Congress adopted a war resolution, which was signed by the President at 4:10 p.m. Three days later Germany and Italy declared war on the United States. (For a detailed account of American military participation in the war, *see* World War, Second.)

Organization for War

With the country actually at war, the government moved to mobilize the manpower and industrial power of the entire nation. The Selective Service Act was amended to cover all men from 18 to 64 years of age inclusive. Those from 20 to 44 were made liable for service in the armed forces; those of 18 and 19 and those from 45 to 64 were to register at the President's call for possible assignment to war work or home defense.

The high command of the Navy was reorganized within the existing framework by shuffling commanders and by giving the most trusted admirals the responsibilities of more than one office. In reorganizing the high command emphasis was put upon previous experience with air weapons and submarines and belief in their effectiveness. The General Staff of the Army was reorganized (*see* United States Government, subhead "The War Department"). The overall direction of the civilian and industrial effort was put in the hands of four principal agencies: the War Production Board, headed by Donald Nelson; the War Manpower Commission, headed by Paul V. McNutt; the Office of Price Administration, headed by Leon Henderson; and the Board of Economic Warfare, headed by Vice-President Wallace and Milo Perkins.

Administrative and Political Problems

The large aspects of the home effort and the general progress made under it are described elsewhere (*see* Nation at War). But at the heart of the effort, the Roosevelt administration faced its own complex problems of internal organization, of expanding re-

sponsibilities, and of securing the assent of Congress to new and more drastic wartime legislation.

The President organized his administration of the war by appointing boards or administrators to handle specific problems, retaining the coördination of efforts in his own hands. Both successes and failures stemmed from this plan. Rapid conversion of the automobile industry to war production was successful, as was the production of planes, tanks, and small arms. Less satisfactory, however, was the handling of the rubber crisis, the supply of steel, and the efforts to curb inflation. Synthetic rubber production was held back by disputes between the advocates of petroleum and alcohol as sources of butadiene, the most critical ingredient (*see* Rubber). Finally the President, on August 6, named Bernard Baruch, the head of war production in 1918, President James B. Conant of Harvard University, and President Karl T. Compton of the Massachusetts Institute of Technology as a board to recommend a definite policy.

President Demands Curb on Farm Prices

The menace of inflation became sharper month by month as prices continued to rise. Critics blamed this upon a provision which the farm bloc in Congress placed in the Price Control Law of January 1942, forbidding ceiling prices upon farm products until they reached 110 per cent of parity (*see* Agriculture), and upon demands for higher wages to meet the rising cost of living. At length, on September 7, the President sent a message to Congress insisting that the farm parity provision must be corrected by October 1 or he would do so by executive action. He also demanded drastically increased taxes to cut down the amount of money available to the public for buying scarce commodities. He promised to stabilize wages when Congress had acted upon the problem of farm prices. Congress responded with its own version of the desired measures.

On September 10 Roosevelt acted on his rubber committee's urgent demand that gasoline be rationed and driving speeds be cut down to conserve the nation's tires. The committee urged that plans be pushed through to get immediate large-scale production of synthetic rubber. The steel situation was equally bad. Armament manufacture was in danger of being curtailed, both because some plants had been allowed to gather steel supplies far in advance of needs and because the country had failed to gather enough scrap metal to keep steel furnaces running at capacity. While none of these shortcomings altered the public's determination to support the government's war efforts, they gave critics grounds for claiming that new men should be elected and appointed to office.

Rising Tide of Opposition and Criticism

On December 17, Leon Henderson resigned as head of the Office of Price Administration. He was succeeded on Jan. 12, 1943, by Prentiss M. Brown, ex-senator from Michigan, who indicated that the agency's enforcement practises would be simpler, though no less stringent, than under his predecessor.

LEADER OF AMERICAN STATESMANSHIP

Secretary of State Cordell Hull—born in a Tennessee log cabin—won a great victory for American diplomacy when he wrote most of the provisions of the agreement signed by the Allied "Big Four" at Moscow in October 1943.

Henderson's resignation came in answer to criticism of his methods and was a further manifestation of growing political opposition to, and scrutiny of, the administration's domestic policies relating to the war. This opposition was clearly indicated by the results of the 1942 congressional elections. The voters sent 9 new Republican senators and 44 new Republican representatives to Congress. In November 1943, the election of several more Republican governors and mayors was interpreted as confirmation of the dissatisfaction with the administration's policies reflected by the 1942 election results. It was evident that the government's effort to hold the wage-price line had alienated the farmers and some of the labor vote.

Criticism of the administration continued to grow in 1943. Strikes by anthracite coal miners during

the summer (*see* Nation at War) provoked a storm of public protest against the handling of the labor situation by the President and the War Labor Board. Finally an exasperated Congress in June passed over Roosevelt's veto an antistrike bill designed to curb work stoppages that would sabotage the war effort.

During the summer and fall of 1943 the halls of Congress echoed with the mounting criticism by senators and representatives. They were outspoken in their denunciation of Allied war strategy that gave secondary importance to the Japanese phase of the conflict and was too much concerned with defeating the Nazis first. Congressmen also called for lower taxes (*see* Nation at War) and for a closer scrutiny of all war expenditures when the Army announced in November that it would shortly reach the end of its expansion.

The congressional revolt against the President's food subsidy measures (*see* Nation at War) had been accompanied by the resignation June 16 of Chester C. Davis as war food administrator in protest against the program. He was succeeded by Marvin Jones, who had presided over the United Nations' food conference in May. A militant Congress also snubbed the Treasury's demand for 10½ billion dollars in new taxes, and in February 1944 passed over Roosevelt's veto new tax legislation calling for only about one-fifth that amount. So wrathful about the presidential veto was the senate majority leader, Alben Barkley, that he rebuked Roosevelt in a speech of resignation. But Democratic senators reëlected Barkley to leadership, and the breach between the President and Congress continued to widen.

Quarrels among heads of various war agencies were aired publicly, to Roosevelt's discomfort. On July 15 he had ended a bitter one between Vice-President Wallace, chairman of the Board of Economic Warfare, and Secretary of Commerce Jesse H. Jones, head of the Reconstruction Finance Corporation, by depriving the two men of their foreign economic activities. These were delegated to the new Office of Economic Warfare, whose director was Leo T. Crowley, head of the Federal Deposit Insurance Corporation. Later this agency was absorbed by the Foreign Economic Administration (*see* Nation at War).

OUTSTANDING ALLIED WAR PLANNER

General George C. Marshall, American chief of staff, who was credited with much of the success of Allied military strategy.

Early in 1944, a soldier vote controversy raged between the recalcitrant Congress and the administration. Roosevelt urged that servicemen be allowed to vote in the impending presidential election under federal supervision, but Congress favored the regular state voting procedure. Meanwhile, Georgia and West Virginia took the lead among the states in amending their voting laws to permit those in the military service to cast ballots wherever they might be. Finally on March 15, Congress passed a bill limiting the use of the administration-sponsored short federal ballot. On March 31, Roosevelt allowed the bill to become law without his signature.

Universal service, or the drafting of labor into essential war work, was yet another subject of conflict between the President and Congress in 1944. Roosevelt contended that a "labor draft" was imperative, while Congress argued that the voluntary shifting of labor to war industries had already been adequate.

American Diplomacy Comes to the Fore

In 1943 Roosevelt and Secretary of State Hull had led the United States to a position of leadership in the field of international diplomacy. Roosevelt's trip to Mexico in April 1943 had further cemented the "good neighbor" relationship with Latin America. Then Hull's leadership in the discussions of the Moscow Conference (*see* World War, Second) was acclaimed an American diplomatic triumph. Another victory for American diplomacy was achieved Jan. 26, 1944, when Argentina finally severed relations with Germany and Japan, thereby strengthening western resistance to the Axis. But American leadership was not confined to diplomatic affairs; the nation's General Marshall was universally regarded as the most influential war strategist in the current conflict.

On Dec. 17, 1943, Roosevelt had signed a bill repealing the Chinese exclusion laws. The new act made all Chinese in the nation eligible for naturalization and permitted 105 of them to enter the country annually.

Fast-moving world events did not deter lively discussion about the presidential election in 1944. Although it was virtually conceded that Roosevelt would again be a candidate, there was much conjecture about his being successful in gaining a fourth term.

The INSPIRING CAREER *of* AMERICA'S *Most* STRENUOUS PRESIDENT

ROOSEVELT (*rō' zĕ-vĕlt*), THEODORE (1858–1919). Boy and man, cowboy and statesman, scientist and historian, soldier and sportsman—the American people have never seen quite the like of Theodore Roosevelt, 25th president of the United States. Had he not wished to devote most of his life to politics, he might have chosen from half a dozen distinct careers, and have gained eminence in any of them. He was as much at home in royal palaces as in the simplest cabin on the Dakota frontier. He was as resourceful in the African or South American jungle as in the White House. Not desiring wealth, he was not frightened by it. He loved power, yet he could use it with moderation. Once, when it was suggested that he would have more power if he were king, he replied indignantly: "Never; I know those kings. They resemble nothing so much as a vice-president for life, plus the leadership of the 400."

THEODORE ROOSEVELT

Rancher, hunter, explorer, author, soldier, statesman, 25th president of the United States, he accomplished in each of his chosen fields of activity as much as many distinguished men accomplish in only one.

Like Jackson, he founded a tradition that long outlived his life. He brought into the government of the United States at the turn of the century, and at the greater turn from local to world affairs, simplicity, honesty, directness, and the overwhelming desire that his children should find the United States as good a place to live in as he had found it. His omnivorous curiosity and aggressive spirit made imprints upon the business of the United States at home and the prestige of the United States abroad. He altered the character of the presidency itself, from a waiting job at the far end of Pennsylvania Avenue, to a coöperating and sometimes controlling job in contact with Congress at the other end of the avenue. But most of all, by the simplicity of his life and the homely virtues of his happy household, he set an example and gave new hope to the American citizen as he, too, faced the problems of a change in civilization. He was the apostle of the useful and strenuous life.

"I began my education early," he wrote "immediately after leaving college," but he never finished it, for his mind at 60 was as open to impressions as it had been at 20. And he may have misjudged the importance of Harvard College in the process, for he left it, in the class of 1880, with a character well formed and with intellectual interests that were never satiated.

When Theodore Roosevelt was a child, Abraham Lincoln, rail-splitter, ran for the presidency, and his supporters made much of his origin in the log cabin of the frontier. There was no pioneer's cabin in Roosevelt's background, no study by the flickering flame of the wood fire. He was born (Oct. 27, 1858) in a brownstone mansion in lower New York, into a family that had known wealth and culture for generations, with ancestors going back to the early Dutch in New Amsterdam. He was educated with all the resources of wealth at his disposal. He had private tutors, and traveled widely. Instead of expecting to work for a living, he knew he would have enough money to do what he pleased. There was family tradition of work and service, with assured means behind it.

It may have been well for the young Roosevelt that this was so, for as a lad he was sickly, near-sighted, and asthmatic, and he might not have been able to cope with a tough world. But it was his own firm determination to build up a serviceable body that did as much to make him as all the family resources. He learned to ride and to shoot. He rather scandalized his elders by learning to box, and by liking to box in public while in college. Indeed, throughout his life nothing was better indication of his technique than his adherence to the boxer's maxim that the best method of defense is to hit the adversary first.

His First Political Service

When he left college he went through the motions of studying law for a few months, but he really spent most of the first year in writing a 'Naval History of the War of 1812'. He appeared in the legislature of New York at the age of 23, and through three terms made himself respected, admired, and sometimes feared. In spite of his youth he was easily the leader of the Republicans in the legislature, and in 1884 was chairman of the New York state delegation to the Republican national convention, where he fought vigorously to secure the nomination of George F. Edmunds over James G. Blaine.

His defeat in this fight came only a few months after the deaths of his mother and his wife, whom he had married on his 22d birthday. The combination

of family sorrows and political defeat seemed to turn his mind away from politics. For the next three years he lived the life of a cattle rancher, on the Little Missouri River in western North Dakota. His rough neighbors liked him in spite of his inexperience and his eastern accent, and he himself appreciated the true worth under their crusty and unprepossessing exteriors.

While he was on his ranch, in the summer of 1886, the Republicans called him to be their candidate for mayor of New York City. He ran a poor third to Abram S. Hewitt, the Democrat, who was elected, and Henry George, the expounder of the "single tax," but he is reported to have said, characteristically, that he "had a bully time." A few weeks later he married Edith Carow, a childhood friend, and settled down to a quiet literary life at Oyster Bay, Long Island. But the call to politics was in his blood; he saw duty and opportunity in public life. When President Harrison offered him the place of civil service commissioner he moved to Washington and for six years had the principal hand in building up the public services so that political influence might be lessened and the work of the nation advanced. He took a police commissioner's job in New York City in 1895, and tried to lift the metropolitan police out of the muck of politics.

President McKinley in 1897 made him assistant secretary of the navy; in this post his chief sometimes thought him like a "bull in a china shop," but his ideal was to make the navy a better servant of the United States. When the war with Spain approached, Roosevelt, who believed fully in its justice, on his own authority quietly ordered preparations for war. He proved his sincerity by taking a commission in the army, and by leading his Rough Riders, the First United States Volunteer Cavalry Regiment, recruited from plainsmen and college athletes, in the inspiring charge on Kettle Hill (wrongly called the charge on San Juan Hill). He came home from war to be nominated and elected governor of New York in 1898.

Roosevelt gained in popularity as one who was unafraid of tradition, and unafraid of change. His gift for publicity and his startlingly aggressive strokes frightened the professional politicians whose timidity made them shrink from new issues. Those who were closest to him, notably Senator Thomas C. Platt, the Republican boss of New York, were glad when Governor Roosevelt came to be discussed as vice-presidential candidate with McKinley in 1900. And Roosevelt, despising the office as one that had no future, and protesting that he was not a candidate, nevertheless accepted the nomination, and was elected. He presided over the Senate for a week during a special session; but before the time came for the Senate to sit in regular session, McKinley was dead, and Theodore Roosevelt, not yet quite 43 years old, was president of the United States.

ROOSEVELT'S ADMINISTRATIONS 1901–1909

- Intervention in Anthracite Coal Strike (1902).
- Alaskan Boundary Dispute arbitrated (1903).
- Department of Commerce and Labor created (1903).
- Railroad Rebates abolished (1903).
- Treaty with Panama for building Canal (1904).
- Louisiana Purchase Exposition (1904).
- Beef Trust declared illegal (1905), and Standard Oil Company indicted.
- Mediation by Roosevelt to end Russo-Japanese War (1905).
- Intervention in Santo Domingo (1905).
- San Francisco Earthquake, April (1906).
- Hepburn Act regulating Railroad rates (1906).
- Intervention in Cuba (1906–09).
- Meat Inspection and Pure Food Acts (1906).
- Oklahoma admitted as a State (1907).
- Japan assents to "Open Door" Policy in China (1908).
- Conservation Conference of state governors (1908).

In 1904, with Charles W. Fairbanks as running mate, he was reëlected president in his own right. He might perhaps have broken the two-term tradition, which had prevailed without exception since Washington declined to consider a third term, and have secured another reëlection in 1908. But he declared that two terms were enough, and retired voluntarily in 1909 to as private a life as "an elderly literary man of pronounced domestic tastes" could live.

Administrative Strength

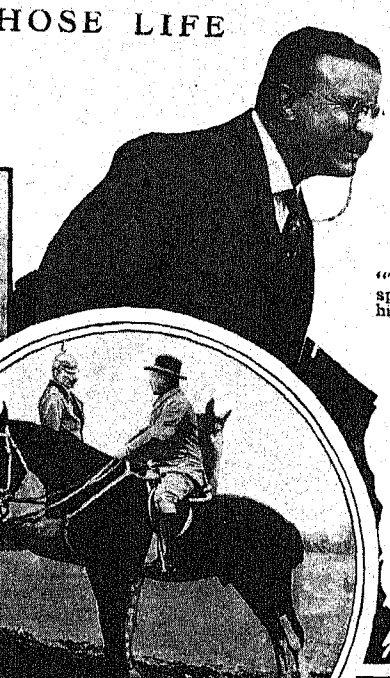
Roosevelt inherited from McKinley a going organization, whose members he continued in their posts until, for reasons of their own, they chose to leave office. John Hay, his old friend, remained as secretary of state. After Hay's death in 1905 Elihu Root took charge of the office. Root had served from 1899 to 1904 as secretary of war, making a splendid record in the administration of the new foreign possessions as well as in reorganizing the army and eliminating the weaknesses which the Spanish-American War had disclosed. The creation of the army general staff and the foundation of the Army War College were largely his work. Root's work in the War Department was ably continued by William H. Taft, who was recalled from the Philippines to take this secretaryship.

To all his traits, Roosevelt added that of supreme administrator, who knew how to delegate duties and get results. Never hurried, he had time for everything. He brought play into the White House; built tennis courts in the rear of the grounds; took his friends on tramps over the hills of the Washington parks; and when army officers protested an order that they show fitness by riding 90 miles within 24 hours,

ROOSEVELT—WHOSE LIFE SPELLED ACTION

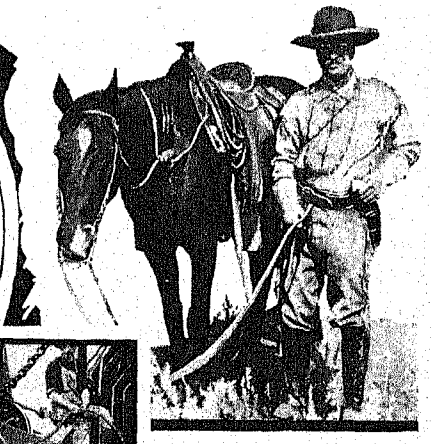
A Human Dynamo, Noted as Statesman, Naturalist, Writer, Soldier, Big Game Hunter, and Explorer

Kermit and his father, below, are sitting on a Cape Buffalo which they have just bagged in Africa.



"T. R." was a very forceful speaker. On the left we see him driving home a point.

The ex-president, at German army maneuvers in 1910, chats with Kaiser Wilhelm (right).

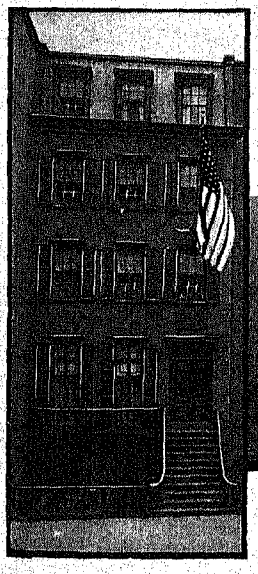


Colonel and Mrs. Roosevelt are seen below, with five of their children—Archibald, Theodore, Jr., Alice, Kermit, and Ethel. Another son, Quentin, born later, was killed in France in the World War.

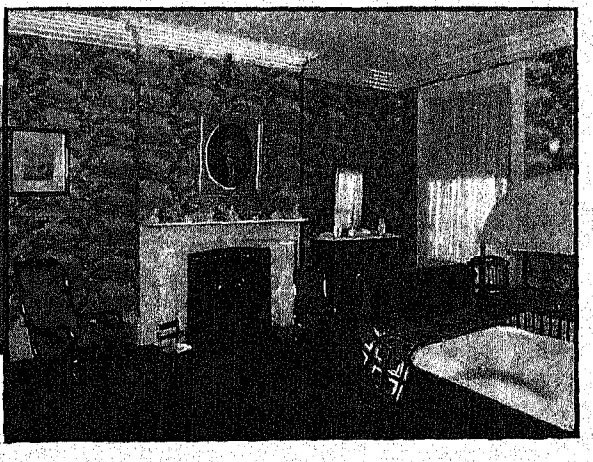
The "strenuous life" of young "Teddy" took him to the Western plains, as we see him above. He became a fine horseman and rifle shot, and during this time he wrote many interesting books about his adventures and studies of wild life.

Roosevelt was always in the midst of activity. Above he is shown inspecting a giant steam shovel during the digging of the Panama Canal.

The room in which Roosevelt was born is shown below. By the fireplace is the little chair he sat in as his mother taught him his early lessons. Teddy was so frail as a boy that he did not go to school, but he studied at home until he went away to college.



We see Roosevelt below, as the colonel of the dashing "Rough Riders," during the war with Spain.



The house in which Roosevelt was born in 1858 is seen at the left. It is now a memorial.

he did it himself between two full working days. His cabinet worked with assurance and decision, under a chief who knew his mind. In the field of foreign relations much of the most decisive work was done.

Foreign Relations

The Alaska boundary dispute with Canada was adjusted during 1903. This dispute, pending since the discovery of gold in the Yukon, involved the meaning of the treaty concluded with Russia by England in 1825, defining the eastern boundary of the Alaskan "panhandle." Roosevelt let it be known to England that he was willing to submit to an arbitration before a special court of six, three members to be appointed by him and three by the British government. The American commissioners were Senator Henry Cabot Lodge, Elihu Root, and Senator George Turner; the British delegates were Baron Alverstone and two Canadians, Sir Allen B. Aylesworth and Sir Louis A. Jetté. Alverstone sided with the Americans on most of the points at issue. The two Canadians refused to sign the award, but it was accepted by both governments and the dispute was thus settled peaceably.

In the winter preceding the Alaska settlement, Roosevelt had occasion to consider how the Monroe Doctrine would be affected by an intervention in Venezuela by Germany, England, and Italy, to collect debts owed to their subjects. They proposed to seize and hold the custom houses, and to pay themselves out of the taxes as they collected them. Deciding that such seizure would be an impairment of the independence of Venezuela, Roosevelt brought pressure upon Germany and the other claimants to arbitrate the claims before the Court of Arbitration at The Hague. He later said that he secretly threatened Germany that he would use force if necessary to stop intervention and the seizure of Venezuelan custom houses.

In 1904, there was threat of a similar intervention, for a similar purpose, in the affairs of Santo Domingo. Apparently at Roosevelt's suggestion, the president of Santo Domingo asked the United States to take charge of the collection of customs, and to divide the proceeds between Santo Domingo and its creditors. Santo Domingo, after paying to its creditors 55 per cent of the revenues collected by an American agent, found that the 45 per cent allotted for expenses of government was larger than the whole revenue had been before. (*See* Santo Domingo.)

The Panama Canal

The Hay-Pauncefote Treaty, clearing the way for an American canal at Panama (*see* McKinley, William), was followed in 1903 by a treaty with Colombia granting the right to build it. But the Colombian Congress rejected this treaty, and in November 1903 the state of Panama, one of the states of the Colombian Republic, seceded, organized an independent republic, and itself by treaty gave to the United States the powers that Colombia had denied. Roosevelt knew about the plans for the Panama revolution, and certainly he gave it support, whether intentional or not, by ordering American naval vessels to keep any hostile forces off the isthmus and to prevent the Colombian troops at Colon from proceeding to Panama City. The President's explanation was that he wanted to avoid bloodshed, and that the United States was bound by treaty to keep the isthmian railroad open. The facts seem to be that he believed that Colombia was trying to blackmail the United States, and that civilization as well as American defense demanded that a canal be built at once. After experiments with a canal commission, he entrusted the work of construction to the United States Army. (*See* Panama Canal.) He sent Taft, secretary of war, to the canal to inspect the work, and later went there himself to get first-hand information.

The "New" Diplomacy of Directness

In dealing with foreign affairs in which the United States had no immediate interest, Roosevelt acted with a new directness which sometimes puzzled diplomats at the same time that it won their admiration. In 1905 he assisted Russia and Japan in bringing their destructive war to an end (*see* Russo-Japanese War); for this service he was awarded a Nobel prize for peace. In 1906, when France and Germany were ready to fight over their interests in Morocco, Roosevelt took the lead in arranging a conference of the powers at Algeciras. Under his instructions the American representative successfully supported the Germans in their effort to maintain an economic "open door" in Morocco, but the French won recognition of their "special position" politically.

Naval Policies of Roosevelt

American prestige was also helped by the improvements in the army and navy. Secretary Root's plans for army reform were firmly backed by the President, and these two men did much to prepare the army for the load that fell on it in 1917. Roosevelt also believed in a strong navy. He pushed Congress hard to get an appropriation for two new battleships a year, and he kept the fleet to a high standard of efficiency. This was demonstrated by the cruise around the world of 16 battleships, all new since the Spanish-American War. President Roosevelt decided on this cruise in 1907 at a moment when relations between Japan and the United States were very critical because of anti-Japanese agitation in California and in Congress, and he always regarded it as one of his most important contributions to world peace. In a letter to Secretary Root he wrote:

> It is high time, however, that it (the navy) should go on a cruise around the world. In the first place I think it will have a pacific effect to show that it can be done; and in the next place . . . I became convinced that it was absolutely necessary for us to try in time of peace to see just what we could do in the way of putting a big battle fleet in the Pacific, and not make the experiment in time of war.

By the close of his presidency, Roosevelt had made it clear (1) that the United States desired peace; at the Second Hague Conference in 1907, the United States delegation took a lead for peace that European powers would not follow; (2) that the United States was prepared to defend its rights, on land or sea,

although it was not disposed to provoke a fight; (3) that the Monroe Doctrine would be maintained by whatever action might be necessary; (4) that, on the other hand, the Latin-American countries would not be allowed to hide behind the Monroe Doctrine as a means of evading their just duties; and (5) that wherever possible the United States, in coöperation with the neighboring republics, would assist them in maintaining order and meeting their obligations. It was also shown (6) that in matters directly relating to the defense of the United States and of the Panama Canal, the United States would act decisively and effectively.

Domestic Problems

Within the United States, Roosevelt found his actions restricted by the need to keep Congress in agreement with him, and by the power of the courts to pass upon the legality of acts. He faced a growing hostility towards himself, on the part of politicians, as he grew more direct and more popular. He faced a more bitter hostility from the managers of "big business" as he took, time after time, positions that favored the people at large against the trusts, and the rights of labor against those of the employer. The boom of a new period of prosperity, visible before the death of President McKinley, became a dominant note in 1901–02. It had distinct results in manufacture, transportation, and labor relations.

The age of steel had begun after the Civil War, when new processes made steel cheap and invaluable for railroads, ships, bridges, and skyscrapers. In 1901 the United States Steel Corporation was formed to control a large share of the total business, and to manage within its own properties every stage in the process from the mine to the finished product. This was the first of the great "vertical trusts" including iron and coal mines, railroads, ship lines, foundries and smelters, rolling mills, and every type of factory for making everything from fence wire and cast iron pipe to locomotives. All the fears of the ordinary people of dominance by the trusts, that had arisen before 1890, now reappeared magnified and intensified, as a new threat of an empire of big business swept the land. It was Roosevelt's view that the trust, just like the common man, must obey the law. But the question was if a suitable law existed; for the Sherman Act of 1890 seemed to have no teeth.

The Railroad Mergers of 1901

Following close upon the industrial mergers, of which the steel corporation was the largest, came a series of railroad mergers. The Union Pacific System, first across the continent in 1869, came to life again after the panic of 1893, and began buying and renting other lines. In 1901 it bought control of the whole of the Southern Pacific System, thus consolidating a railroad empire that threatened with monopoly the whole southwestern quarter of the United States. Close upon this, the Northern Pacific, the Great Northern, and the Burlington systems were brought together under the Northern Securities Company, constituting another near-monopoly, this time over the northern half of the Far West.

In 1902, through Atty.-Gen. Philander C. Knox, Roosevelt brought suit under the Sherman Act, for the dissolution of the Northern Securities Company as a conspiracy in restraint of trade. The United States won the suit. By this time Roosevelt was being called the "trust buster," a useful term in getting votes. Suits were begun against the United States Steel Corporation, the Standard Oil Company, and other large combinations, but the President tried to make it clear to the people that mere size was not the trouble; that it would be better to stop bad practises than to try to break up the corporations.

Naturally big business thought the President too radical, for his proposed reforms threatened to reduce profits. The President, on his side, was appalled by the attitude of some of these men. In a letter to Senator Lodge he quoted Harriman, who controlled the Union Pacific System: "Harriman answered . . . that whenever it was necessary he could buy a sufficient number of senators and congressmen or state legislators to protect his interests, and when necessary he could buy the judiciary. These were his own words. He . . . showed a perfectly cynical spirit of defiance throughout, his tone being that he greatly preferred to have in office demagogues rather than honest men who treated him fairly." Roosevelt's own attitude he expressed in a letter to a New York banker: "I wish to do everything in my power to aid every honest business man, and the dishonest business man I wish to punish simply as I would punish the dishonest man of any type. My prime object is to prevent injustice and work equity for the future."

Passage of the Pure Food Law

From every side, suggestions began to come to Congress for more laws to help the people against big business. A Department of Commerce and Labor was added to the cabinet in 1903. The Pure Food Law was passed in 1906, requiring the packers of food to label correctly what they sold, and forbidding the use of injurious drugs and adulterants. In the same year the Hepburn Law was passed, extending the powers which the Interstate Commerce Commission had exercised since 1887, and specifically giving it the right to fix rates and making it a quasi-judicial tribunal.

The continued attacks on large corporations undoubtedly helped to bring on the panic of 1907. In 1906 Charles E. Hughes led an investigation of the New York insurance companies (*see* Hughes, Charles Evans), and disclosed many abuses which created public distrust of the existing managements. The uneasiness of the public was indicated in the stock market early in 1907, but did not come to a head until October, when the Knickerbocker Trust Company, in New York, failed. Though the country as a whole was prosperous, the reserves of almost all the nation's banks were concentrated in New York. There the money crisis became acute, and "runs" started on many of the trust companies and other financial institutions.

The banks refused to pay out cash, but issued "clearing house certificates," secured by gold and securities in the hands of members of the clearing house. Chicago and other large cities followed New York's example, until in all about $250,000,000 was added in this way to the currency in circulation. Such certificates had been issued several times during the Civil War, in the panics of 1873 and 1893, and at several other critical periods.

Roosevelt established a friendlier relationship with labor than any previous president had done. In 1902 there was a great strike among the coal miners in the anthracite fields of Pennsylvania. The miners kept good order, so that there was no excuse for troops. The mine owners refused stubbornly to deal with the unions. As winter approached, Roosevelt made ready to take over and to operate the mines in the interest of the public, but he also brought such pressure upon the owners that, unwillingly, they agreed to arbitrate. The President appointed a special commission of seven, and the verdict of these men, giving the strikers a part of the wage increase they wanted, was accepted by both sides. Labor, which had sometimes believed that the government was always against the workers, continued to give Roosevelt strong support.

The Far West always held a particular interest for President Roosevelt, for there he had passed years upon his Dakota ranch and there he had often traveled hunting big game. He assisted in 1902 in the passage of a Reclamation Act for building great irrigation dams and canals in the arid states (*see* Irrigation and Reclamation). In 1908, he gathered at the White House a conference upon the conservation of natural resources, assembling there governors, university presidents, men of business, and scientists to consider what policy ought to be adopted to preserve the national estate for posterity. One result of this conference was the formation of the National Conservation Commission (*see* Conservation).

Roosevelt had done his best work in reviving the conscience of the people upon matters of social justice, and in holding their attention to the great policies to be undertaken by the United States so that the ordinary man might remain economically free in spite of great combinations of wealth. He secured the Republican nomination for his friend William H. Taft, and left to him the arduous task of carrying out the measures that had come to be known as the "Roosevelt policies" (*see* Taft, William Howard).

The Ex-President

The United States makes no provision for using its ex-presidents. Roosevelt left the White House only 50 years of age, with wide interests, ample private means, and the prospect of many years of active life. He knew that he had reached the climax of his career, and that nothing again could be as exciting as having been president. He took up his residence at his country estate on Long Island, at Oyster Bay, and became the most important private citizen in the United States.

He resumed his travels, and the hunting trips that were also scientific expeditions. These hunting trips of Roosevelt were those of a naturalist, not interested in killing game but thrilled with the thought of discovering new varieties and gathering specimens for museum use. Early in life, he had helped to found the Boone and Crockett Club, whose mission was the preservation of American big game. When he left the White House in 1909, he departed at once to Africa, where he led an expedition into the interior, for the American Museum of Natural History. He explored the back country of Brazil in 1914, nearly losing his life through disease and accident. But he located what had appeared upon the maps as the River of Doubt, and the Brazilian government promptly renamed it the Roosevelt River in his honor.

His Return to Politics

On his return from Africa in the summer of 1910, he was drawn back into politics. He was inspired by a belief that Taft had failed to carry through the Roosevelt policies, and that he was needed to preserve the life of the progressive movement which he had helped to start. He spoke and wrote on "new nationalism," meaning by this that the United States must control all forms of business sufficiently to protect the interests of the American people; and that if the Constitution did not grant enough powers for doing this, the Constitution must be amended. His friends, who could not get used to his absence from politics, urged him to be a candidate for president in 1912. Politicians too, who cared little for him personally, urged his return, because they believed that he alone could prevent the election of a Democratic president. He was beaten for the Republican nomination by Taft, under circumstances which led to charges of fraud and "steam-roller" methods.

Thereupon the Roosevelt followers organized a new party, the "National Progressive," held another convention, and nominated Roosevelt for president and Senator Hiram W. Johnson for vice-president. The party was nicknamed "Bull Moose," because Roosevelt, once when asked how he felt, replied that he was fit as a bull moose. The platform demanded direct primaries, direct election of senators, the initiative and referendum, suffrage for women, and other reforms of a social-economic nature. An enthusiasm that was almost religious animated the new party. The campaign was bitter, and Roosevelt's attacks on the "stand pat" Republicans were more venomous than on the Democrats who were his normal opponents. Though not expecting to win, Roosevelt led a gallant fight, and made a two months' speaking tour of the country. In Milwaukee, at the height of the campaign, he was slightly wounded by a crazy man who shot at him. Roosevelt polled 4,126,020 votes, to 6,286,214 for Wilson, and had 88 electoral votes to 435 for Wilson. Taft was third with 3,483,942 popular votes and 8 electoral votes.

When the World War came, he watched its progress with keen understanding. From the first he felt that

Germany was in the wrong, but he wished to avoid any action which might embarrass President Wilson in formulating a policy of neutrality. Very soon, however, he came to the conclusion, as he wrote in a letter to Rudyard Kipling, that Wilson "had no policy whatever," and thereafter, until the United States was drawn into the war, nothing that the Democratic administration could do was right. He led rallies for "preparedness," urging Congress to complete the arming of the United States before it was too late, and he denounced every form of pacifism. He refused the Progressive nomination for president in 1916, and supported Hughes, the Republican nominee, against Wilson, who was reëlected.

When at last the United States declared war against Germany, Roosevelt hurried to Washington to offer, once more, his services. For nearly a year he had been ready, with a skeleton organization of a division, and with acceptances from all the higher officers he would need. But there was no place for Roosevelt in the war. He was nearly 60 years of age; he was not a professionally trained soldier, and high military command was entrusted only to those who were; he was physically unfit, for he never fully recovered from the fevers which attacked him during his search for the River of Doubt, and he had long since lost the sight of an eye through an accidental blow while boxing for exercise. Although he could not go himself, his four sons and his son-in-law were all in active service. Quentin, the youngest son, a pilot in the Aviation forces of the United States, lost his life in action.

As the war progressed, too slowly for those who feared defeat, Roosevelt led in the demand for ever-greater activity. But his constitution, worn by strenuous activity, broke under him, and on Jan. 6, 1919, he died quietly in his sleep. He is buried in the cemetery near Sagamore Hill, his home at Oyster Bay. Each year on his birthday, October 27, which is also observed as Navy Day in his honor, the tomb becomes a place of pilgrimage. His father's residence, at 28 East 20th Street, New York City, where as a lad he lived, has been made into a museum by the Roosevelt Memorial Association.

Roosevelt's chief writings were: 'Life of Thomas Hart Benton' (1886); 'Life of Gouverneur Morris' (1887); 'Ranch Life and Hunting Trails' (1888); 'The Winning of the West' (1889-96); 'American Ideals and Other Essays' (1897); 'Life of Oliver Cromwell' (1900); 'African Game Trails' (1910); 'The New Nationalism' (1910); 'Theodore Roosevelt, an Autobiography' (1913); 'Life Histories of African Game Animals' (1914); 'Through the Brazilian Wilderness' (1914); 'Fear God, and Take Your Own Part' (1917).

ROOT. The two important functions of roots are to anchor and support the plant and to absorb water and minerals found in the soil. A plant possesses a "tap-root" system when it has one stout prominent root extending for some distance into the soil. The "fibrous" root system is very different, with slender roots, much branched, as in the bean, corn, etc. Thickened or fleshy roots developed in clusters, as in the dahlia, are called "fascicled" roots. Roots are classified as soil, air, or water roots according to the medium in which they grow.

Each root is generally capped by a blunt root-cap of firm cells, which protect the delicate growing tip. Behind this cap are usually many slender root-hairs, which are devoted to the absorption of liquid foods and are constantly dying off and being renewed. It is popularly believed that the roots "nourish" the plant with minerals drawn from the soil. This is a mistake. The water and dissolved minerals taken up with it by the roots are essential to the building of the plant cells, but by far the largest proportion of the plant's food is derived from the carbon dioxide absorbed by the leaves (*see* Leaves).

Roots absorb the moisture from the soil through the tiny membranes of the root-hairs by a process called "osmosis," which causes the thinner watery solutions of the earth to be drawn through the membrane by the attraction of the thicker sap solutions in the root cells. Air is also taken from the soil by the roots for their own "breathing."

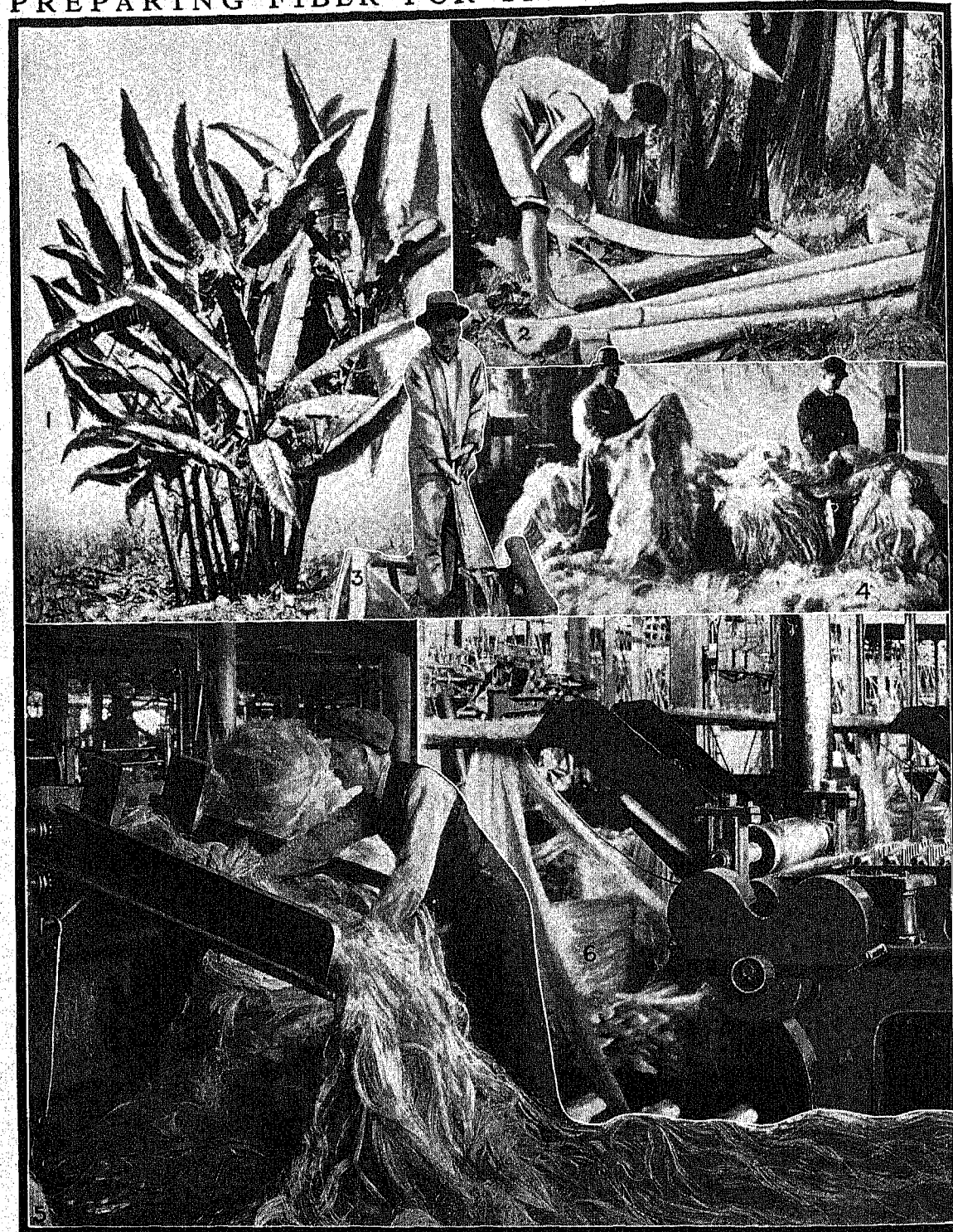
The force exerted by roots as a result of growth is remarkable. In rocky places it is a common thing to see small crevices in the rock where the slender roots of trees enter and split the rock apart as they enlarge (*see* Plant Life).

ROPE AND TWINE. The mention of rope suggests salt water, tarred rigging, ships being anchored or towed or docked, wharves, and big loads being hoisted. It makes us think of the din of the building industry, Alpine climbing, the cowboy swinging his lariat, or even a tug-o'-war. Rope is one of the most common and useful articles in man's existence; but the story of its development into the giant 23-inch cables and hawsers of today, capable of lifting a locomotive or a torpedo boat, goes out of sight into the far past.

Man's earliest cords or lines for fishing, tying animals, etc., were mere fibrous roots, strips of bark, or hide thongs, such as certain savage tribes still use. Ancient Egyptian inscriptions are believed to portray a form of rope making. Prior to 1820, rope was made entirely by hand. The picturesque 'rope-walks' or old time hand process factories, established in Boston as early as 1642, were among the earliest industrial establishments in the United States. Then came machines for twisting hand-spun yarns into rope strands, and later yarn-spinning mechanism was developed. Near the middle of the 19th century steam-driven machines were introduced for making not only all cordage an inch or more in circumference —which goes by the general name of rope—but also all smaller cordage, called string, cord, or twine.

Cordage is made of various kinds of hemp, or fibers known under the name of hemp, especially manila fiber and its cheaper rival, sisal fiber, now much used in manufacturing binding twine for self-binding grain reapers, etc. (*see* Hemp). Other materials used are flax, cotton, East Indian jute, and coir, the fibrous casing or bark of the coconut.

PREPARING FIBER FOR SPINNING INTO TWINE

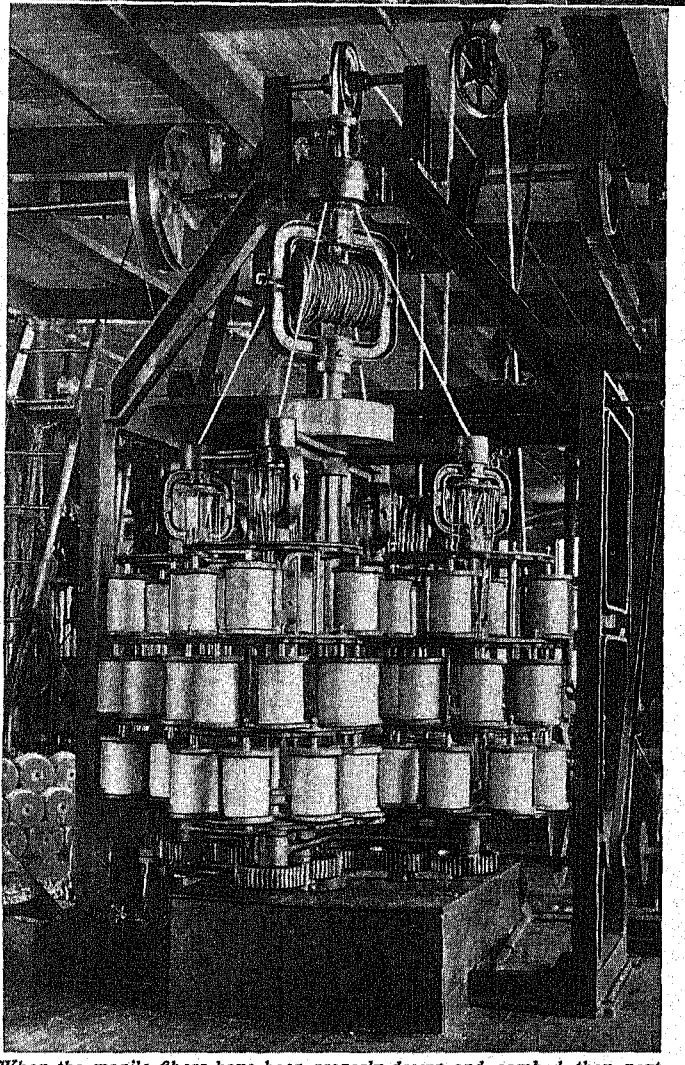


When you walk away from a store with a little ball of manila twine in your hand, you little realize that you are giving that twine its last lift on a journey that has covered thousands of miles, over land and sea. Before any man touched it, it was a part of the manila plant (1), which is a native of the Philippine Islands. Until recent years practically all twine was made of manila, but now Mexican sisal, being cheaper, is also used widely. The manila plant is cut down by a brown-skinned little Filipino, who uses only primitive tools, perhaps a hatchet, but sometimes only a sharp stone or a forked stick (2). Another Filipino breaks the stalk into layers or strips (3), after which it journeys to some warehouse where it is carefully examined and sorted (4) before being shipped to America for manufacture into twine. Arrived at the factory, the fiber is first softened and combed (5) into long ribbons called "slivers." These usually go through a second combing or drawing (6), and sometimes more, depending on the grade of fiber and the desired quality of the finished twine.

SPINNING THE PREPARED FIBER INTO TWINE

The raw material arrives at the rope-making plant in great bales. It is loosened, spread in layers, sprinkled with oil, and then "heckled" or mechanically combed to clean and straighten the fibers. The fibers are twined and twisted end to end into one continuous *sliver* on machines called "breakers." Later the slivers go to the spinning machines. These twist the fiber right-handed into yarns, which are mechanically wound onto huge bobbins.

From the bobbins the yarns are fed to the strand-forming machine through holes in an iron face plate, so placed that the yarns all converge into a tube, where they are compressed into a bundle and twisted into strands by the revolution of a long carriage or flyer. In the "laying" machine the strands again pass through openings and converge in a central tube, through which they pass to a second set of revolving flyers; and these twist the strands together into rope. (In the most complete rope-making instrument the strand-forming machine and the laying machine are combined.) Thus rope-making is a series of twisting processes; and each twist is in a direction opposite to that of the preceding twist, so as to make the finished product tight and hard. Ropes are twisted together to form a larger rope, hawser, cable, etc.



When the manila fibers have been properly drawn and combed they next journey to the spinning room (upper picture), where they are first twisted right-handed into yarns, wound on large bobbins. The lower photograph shows the last processes of laying and forming the strand. At the top is one of the large bobbins, below that the revolving flyers which spin the strands together into twine and finally at the bottom, the many spools of finished twine.

The cordage is still frequently covered with pine tar or other tar (by means of copper troughs and pressing rollers) to protect it from the effects of moisture. But hemp ropes have been largely superseded in many industries by powerful wire cables, made of copper, iron, or steel wires twisted together in much the same way that hemp ropes are made.

Rose. Since the days when the "sweet singer of Israel" sang the praises of the Rose of Sharon, civilized man has extolled the rose above all other flowers. In ancient Greece it was sacred to Aphrodite, goddess of love. The Romans used incredible quantities of roses, stuffing couches with their petals, scattering them in palace halls, and even in the streets. At a single feast Nero is said to have spent $150,000 for roses! On one occasion his rose showers were so abundant that some unlucky guests were literally smothered. A white rose was the symbol of secrecy. Suspended from the ceiling at ancient banquets, it enjoined silence regarding everything said and done; the expression *sub rosa* still means "confidentially." Throughout the Middle Ages ran a thread of rose-romance; for this was the flower of chivalry and love, as well as the badge of the two great English families who fought the Wars of the Roses.

The rose is the national flower of England, Rumania, and Persia. The white Cherokee rose which grows wild in the southern United States is the state flower of Georgia, and the wild prairie rose is the state flower of Iowa, New York, and North Dakota.

Municipal rose gardens are becoming increasingly popular. The Roseraie de l'Hay near Paris and the great Bagatelle Rose Gardens in that city are among the largest and best known. In the United States the American Rose Society sponsors such gardens as the International Rose-Test Gardens of Portland, Ore. In England the National Rose Society maintains experimental gardens. And there are beautiful national gardens in Rome and in Ballarat, Australia. Roses have a commercial as well as an esthetic value. In southern France and Bulgaria they are cultivated for the oils which form the base of fine perfumes (*see* Perfumes). Roses grown in greenhouses in the United States have an annual value of some $20,000,000.

Roses are native only to regions north of the equator, and grow wild throughout the north temperate zone, but they are cultivated all over the world. Some species are native to high altitudes in the tropics, and others to the Arctic regions. Roses belong to the genus *Rosa* of the family *Rosaceae*. The family also includes the apple, pear, plum, peach, blackberry, raspberry, strawberry, and such ornamental plants as the mountain ash and hawthorn. Roses are erect, climbing, or trailing shrubs, usually with prickly or hairy stems, and with flowers borne either singly or in terminal clusters, followed by a berry-like fruit.

The wild roses all have single blossoms with five petals and numerous stamens and pistils. In the many-petaled cultivated varieties the stamens are transformed into petals. The best-known American species are the prairie rose (*Rosa setigera*); the swamp rose (*R. carolina*), found in damp thickets from Canada to the Gulf of Mexico; and the Cherokee rose (*R. laevigata*). The sweetbrier or eglantine (*R. rubiginosa*) is an Old World species naturalized in the United States. The Alpine rose (*R. alpina*) of Switzerland and the Pyrenees is a climber, with pink or red flowers.

Roses respond so readily to man's experiments that there are now hundreds of cultivated garden varieties. They are classified as summer roses, blooming but once in a season, or as remontant or autumnal roses, blooming more than once, some continuously throughout the season. The more important groups include the tea roses, hybrid teas, hybrid perpetuals, polyanthas, and a number of climbers, or ramblers.

Roses, Wars of the. A quarrel between the noble families of York and Lancaster over the right to occupy the English throne brought on a series of the cruelest and most brutal civil wars in English history, in the years 1455–1485. Because the emblem of the Yorkists was a white rose and that of the Lancastrians a red rose, they were called the Wars of the Roses. The struggle was largely a contest for political power between the nobles, and did not greatly affect the common people.

To understand the contest, you will need to look at the table on page 158, and see how the families of York and Lancaster were descended from King Edward III. Henry VI, the head of the Lancastrian house, represented the third line of descent from Edward III. Richard of York was descended through his mother from Edward's second son and through his father from the fourth son. By strict rules of inheritance the Yorkists had a better claim to the throne than the Lancastrians did. But they had been passed over in 1399 when Richard II was deposed, and would have won no backing for their claims later if it had not been for the failure of the English armies in the Hundred Years' War (*see* Hundred Years' War), the mental and physical weakness of King Henry VI, and the excessive taxation and misrule at home.

Leaders in the First Wars

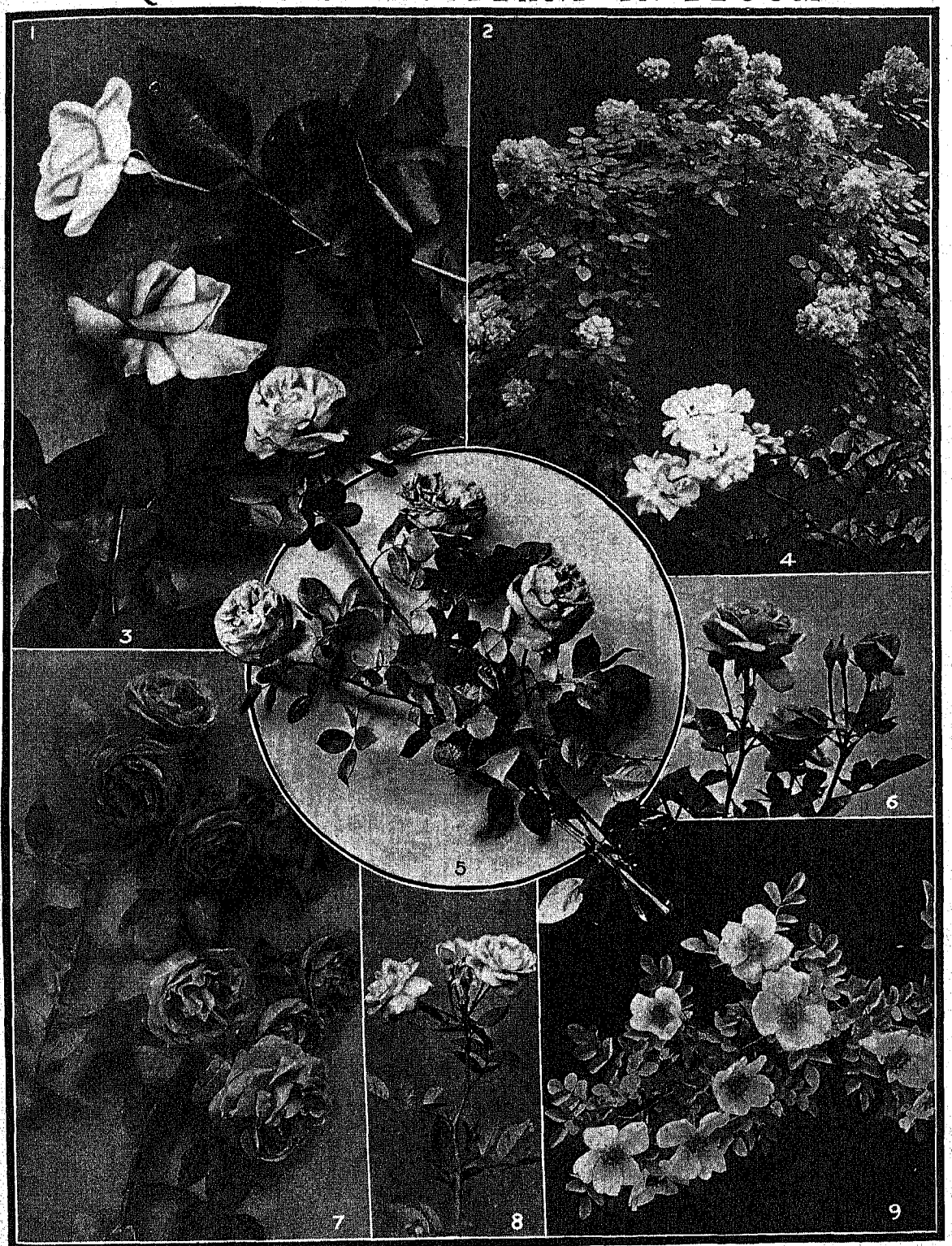
At first Richard of York planned merely to take the government from incapable persons and secure it for himself, but later his ambition was to seize the crown. His ablest supporter was the Earl of Warwick, who played so important a part, first on one side and then on the other, that he was called "the Kingmaker." On the Lancastrian side the real head of the party was Queen Margaret, a young and beautiful Frenchwoman, who fiercely resisted the attempts to dethrone her husband, Henry VI, and disinherit her son, Prince Edward.

The struggle began with the battle of St. Albans, in 1455, in which Richard of York was victorious and secured control of the government. Four years later the contest was renewed, and after varying fortunes Richard was defeated and slain in battle by the forces of Queen Margaret at Wakefield (1460). But Richard's strong and able son obtained the throne, by Warwick's help, and became king as Edward IV, the first of the Yorkist line. Poor insane Henry VI was shut up a prisoner in London Tower. Then Warwick quarreled with Edward IV, and aided Queen Margaret to drive him from England and restore Henry VI (1470). But the following year Edward returned and Warwick was defeated and slain in battle. King Henry's young son was captured and murdered at Tewkesbury (1471). The King himself was assassinated the day Edward IV reëntered London and seized the throne again.

The End of the Wars and Their Results

This ended the first period of the struggle. Fourteen years later war broke out again, and Henry Tudor, the last Lancastrian representative, defeated and slew Richard III, last of the Yorkist kings, at the

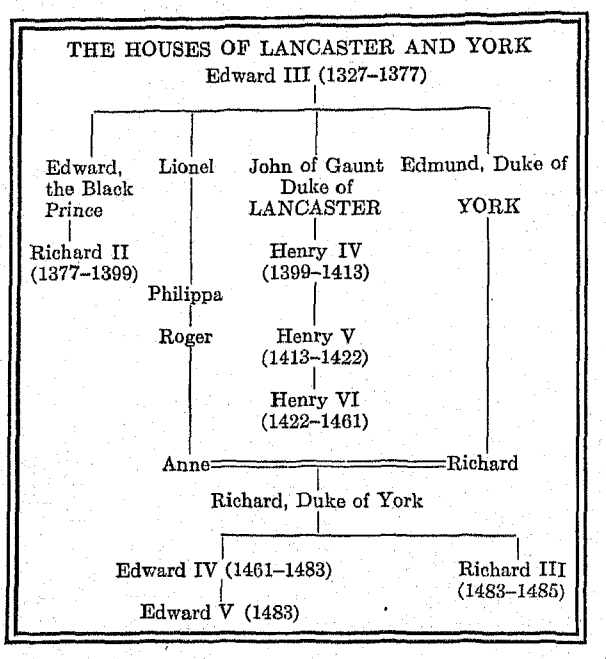
QUEENS OF ROSELAND IN BLOOM



Here are only a few of the many varieties of roses which the care and science of men have developed. In the upper left-hand corner is the Ophelia (1), while immediately below it is the Columbian (3). In the upper right-hand corner, embedded in the arc of thick foliage are many Ramblers, (2), with a Polyantha (4) closing the wreath. The circle in the center shows what many people consider the queen of them all—the American Beauty (5). To the right of it is the Hybrid Tea Rose (6), a cross between the true Tea Roses and the Hybrid Perpetuals, and far hardier than the Tea Roses. In the lower left-hand corner is the yellow "Marshal Niel" (7) and next to it the China Rose (8). The lower right-hand corner shows the common Prairie Rose (9).

battle of Bosworth Field (Aug. 22, 1485). The victor became king as Henry VII, thus ending the Wars of the Roses. The following year Henry married Elizabeth of York, the daughter of Edward IV, and the white and the red roses were united in the rose of the Tudors, the emblem of a new line of English kings.

The Wars of the Roses broke the feudal power of the nobles, and so marked the end of the Middle Ages in England. Many of the ruling nobles were slain in the wars and their estates were confiscated by the crown. Lawlessness, which had torn England since the beginning of the Hundred Years' War, had grown even worse during the Wars of the Roses. Not enough able leaders remained to maintain law and order. "Few would venture alone into the country by day and fewer still into the towns by night." The common people longed for a strong government that would bring peace and prosperity. Henry VII seized the opportunity to reëstablish the royal power and to initiate policies that marked the beginning of modern England. (*See also* Lancaster; Tudor; and articles on the individual rulers named above.)



ROSSETTI, CHRISTINA GEORGINA (1830–1894). Love of nature, understanding of children, and a simplicity that is high art are among the qualities that won Christina Rossetti a high place among 19th-century poets. That is why children, as well as their elders, enjoy and love such lines as these:

> Who has seen the wind?
> Neither you nor I:
> But when the trees bow down their heads,
> The wind is passing by.

Christina, born in London Dec. 5, 1830, was the youngest of the four children of Gabriele Rossetti, a political refugee from Italy. All these children became famous: Maria Francesca, as a writer; Dante Gabriel, as a poet and painter; William Michael, as a critic; and Christina, as a poet.

A Genius Which Flowered Early

Christina was lively, clever, and rather precocious. Like the other Rossetti children, she got the better part of her education at home, where she met exiled politicians, artists, and literary men. Her first verses, written when she was 12, were privately printed by her grandfather. At 19 some of her poems were printed by her brothers in *The Germ*, the magazine of the Pre-Raphaelite Brotherhood. But general recognition did not come until 1862, when her 'Goblin Market, and Other Poems' was published. 'The Prince's Progress' was published four years later and in 1872 there appeared the delightful collection of her earlier writings for children, 'Sing-Song'. Her later works in prose and verse were mostly religious. She died Dec. 29, 1894.

Christina Rossetti's poetry was remarkable for its singing quality. It reflected and was often inspired by her religious scruples and her strong sense of duty. Although occasionally melancholy and even bitter, because of poor health and two unhappy love affairs, yet she was often sprightly and fanciful. She was beautiful in a quiet and grave manner, and was the model for many paintings by her brother Dante and his artist friends. The story of her life, told by W. M. Rossetti, may be found prefaced to her 'Poetical Works' (Macmillan, 1904).

ROSSETTI, DANTE GABRIEL (1828–1882). Equally gifted as painter and poet, Dante Gabriel Rossetti is remembered both as the leading figure in the Pre-Raphaelite Brotherhood and as the author of such well-loved poems as 'The Blessed Damozel', 'Jenny', 'Sister Helen', and the 'House of Life' sonnets.

He was born May 12, 1828, two years earlier than his famous sister Christina (*see* Rossetti, Christina). Like his sister, he showed his talents early. When he was five years old he wrote a drama, and at about 16 he wrote a story which was privately printed by his grandfather. After attending King's College School for a few years, he began to study art. School routine irked him, however, and to the end of his life his drawing was faulty. He was strongly influenced by Ford Madox Brown, then a rising young painter, in whose studio he worked for a time.

The Pre-Raphaelite Brotherhood

When he was about 20, Rossetti became closely associated with Holman Hunt and J. E. Millais. These three youthful artists, despising the facile imitativeness and mediocrity of the current art tradition, formed the Pre-Raphaelite Brotherhood. The name indicated their intention to return to the directness and truthfulness of medieval art before the days of Raphael. Other artists and writers later became associated with the movement. Edward Burne-Jones, William Morris (*see* Morris, William), Swinburne,

and Rossetti's sister Christina were among these. Rossetti encouraged the others to express themselves both in painting and poetry as he did. His most famous poem, 'The Blessed Damozel', appeared in *The Germ*, a magazine of the Pre-Raphaelite group.

In 1860 Rossetti married the beautiful Elizabeth Siddal, a milliner's assistant, who became the model for many of his paintings. Not quite two years later she died. Agonized with grief, Rossetti had the only manuscript of his poems (as yet unpublished in book-form) placed in her coffin. In 1869, however, he had the coffin unearthed and the poems taken out. Great as would have been their loss to English literature, some find this act of his hard to forgive.

Though his canvases are remarkable for their glowing color and mystical beauty, Rossetti was a surer artist in his poems. No poet was ever more romantic. His brother has told us that his earliest influences were Shakespeare, Scott, Byron, and the Bible. Then came Shelley, Mrs. Browning, the older English and Scottish ballads, and Dante. Rossetti's own poetry, whether in the romantic legend, the ballad, the sonnet, or the lyric, is full of rich colors. Over-luxuriance of phrase is a fault; but his best poetry has a precision of imagery which is extraordinarily effective.

Some of Rossetti's best-known paintings are 'Ecce Ancilla Domini', 'Beata Beatrix', 'Paolo and Francesca', 'Dante's Dream', 'Borgia', 'Proserpina in Hades', and 'Hesterna Rosa'. Much of his best poetical work, including the famous sonnet-sequence 'The House of Life', is found in 'Ballads and Sonnets', published in 1881.

ROTHSCHILD FAMILY. For most of the 19th century, the House of Rothschild, a Jewish family of bankers, ruled the money markets of Europe. It was from the Rothschilds that nations borrowed money to pay their debts, to carry on wars, or to finance vast peacetime projects.

Meyer Amschel Rothschild (1743–1812) laid the foundation of the family fortune. He was born in the ghetto (Jewish quarter) of Frankfort-on-the-Main, in Germany. There he set up shop as a tradesman and money-changer, as had many generations of Rothschilds—so called because one of them had taken a red shield (German, *rothen Schild*) for the sign of his shop. An expert in rare coins, Meyer Amschel gained access to homes of the rich, notably to that of the Elector William of Hesse-Cassel. Soon he was entrusted with some of the elector's important affairs. Meanwhile he trained his five sons to work as a team for the profit of the Rothschild family.

The Rothschilds owed their rise as international bankers largely to the Napoleonic wars. Meyer Amschel's third son Nathan (1777–1836), who had gone to England about 1800, ran goods through Napoleon's blockade at great profit. He also devised and carried out, with his brothers' help, a clever plan to get gold through France to finance Wellington's army in Spain. This led to a post for Nathan as agent of the British treasury, and at the close of the war the House of Rothschild was commissioned to handle loans to France and Austria. Nathan's brother Jacob, or James (1792–1868), set up a bank in Paris, and his brother Solomon (1774–1826), a bank in Vienna. Another brother Karl (1788–1855), later established a bank in Naples, while the eldest brother, Anselm Mayer (1773–1855), remained in charge of the business at Frankfort.

Under the five brothers and their descendants, the House of Rothschild flourished throughout the 19th century. Their business included the financing of European wars and of railroads in Europe and in America. They also participated in loans to the United States in 1871 and 1895. Nathan's son Lionel (1808–79) in 1875 lent the money with which Disraeli bought control of the Suez Canal. Lionel was the first professing Jew to be elected to Parliament, and his son Nathan Meyer (1840–1915) was the first Lord Rothschild. In the 20th century, Rothschild power in world affairs declined, although they continued for some time to add to their fortune.

ROTTERDAM, NETHERLANDS. The second largest city in the Netherlands and the most important commercial port, Rotterdam lies 15 miles from the sea on the Maas, or Meuse, River at its junction with the little river Rotte. The Rotte dike gave the city its name, which means dam (or dike) of the Rotte River. During the German invasion in 1940, large sections of the city were laid waste by aerial bombs.

Hundreds of acres of docks and basins on the Maas take care of the large ocean-going ships which bring cargoes of coffee, tea, tobacco, flour, sugar, spices, oil, cotton, lumber, iron ore, and carry away Dutch manufactures and food products. The city is also a center for the traffic on the Meuse and Rhine rivers. Shipbuilding is the leading industry. Sugar refining and the manufacture of cigars, margarine, paints, rope, furniture, and leather are also important.

The site of the city is so low and spongy that most of the houses are built on piles. Tree-bordered canals run through the city in all directions. The oldest quay is called the Boompjes, or "little trees." One of Rotterdam's most cherished treasures is a statue of the great scholar Erasmus, who was born here in the 15th century. In the Boymans Art Museum (spelled also Boijmans) may be found the works of Ruysdael, Jan Steen, van Goyen, de Hooch, and other Dutch masters. Population, about 580,000.

ROUND TABLE. When King Arthur of Britain gathered about him his chosen knights—so the old legends tell us—they sat around the famous Round Table, so that there might be no quarrels about rank and that the king might sit among them a man among equals. The name "Round Table" came to be applied to the knights themselves, as the title of the mythical order of chivalry—

> . . . that fair Order of the Table Round,
> A glorious company, the flower of men,
> To serve as models for the mighty world
> And be the fair beginning of a time.

According to the Arthurian romances, the table was made by the wise magician Merlin, and it came into

Arthur's possession with the dowry of his queen, Guinevere. The legends differ as to the number of knights; some place the figure as low as 50, and others increase the number that the table would seat.

Noted Champions of the Round Table

Only the best and most valiant knights were adjudged worthy of a place at the Round Table. Each chosen knight had his own seat with his name carved upon it. The members formed a brotherhood bound by oath to help one another in danger and to refrain from fighting among themselves. In the goodly company were brave Sir Perceval de Galis, one of the men that most believed in Christ; Sir Lancelot, beloved by the fair Elaine of Astolat, and Sir Bors de Ganis, his cousin; Sir Gawaine, Sir Gareth of Orkney, and Sir Gaheris, all brothers, and nephews of King Arthur; Sir Tristram (or Tristan) of Lyonesse, the best huntsman of the world and the noblest blower of a horn; Sir Kay, the seneschal of King Arthur's court; Sir Ector de Maris, who was cured of his wounds by the Holy Grail; the traitor Sir Modred, who usurped the throne and tried to wed Queen Guinevere, but was killed in combat with King Arthur; the noble Sir Bedivere, who received the last commands of the king and became a hermit after Arthur's death; Sir Lamorak de Galis, Sir Sagramore le Desirous, Sir Palamides the Saracen, Sir Bleoberis, and many other brave and noble knights.

One seat, however, known as "the Seat Perilous," had no name upon it. It was reserved for him who should succeed in the search for the Holy Grail—that mystic cup from which Christ had drunk at the Last Supper. It was filled at last by Sir Galahad, the perfect knight. Tennyson tells many of the stories of the Round Table in his 'Idylls of the King'. (*See* Arthur, King; Galahad.)

ROUSSEAU (*rụ-sō'*), JEAN-JACQUES (1712–1778). This famous French philosopher gave better advice and followed it less than any other great man who easily comes to mind. He wrote glowingly about nature, yet spent many of his days on a city pavement. He praised the beauties of domestic life and wrote wisely about the education of children, but he lived with his cook and abandoned their babies. He taught hygiene, but lived in a stuffy garret. He preached virtue, but was far from virtuous. Rousseau was indeed a strange vessel for the wisdom he contained. But his teachings in politics, literature, and education had a profound influence on the thought of his time.

Of French Huguenot descent, Rousseau was born at Geneva, Switzerland. He grew up undisciplined and at about the age of 16 he became a vagabond. He roamed through Switzerland, Italy, and France, earning his way as secretary, tutor, and music teacher and learning first-hand the lives of rich and poor. When he went to Paris in 1741 to try his fortune, he was impressed by the fact that French society was artificial and unfair in its organization. It lived by rules made by the aristocracy and was little concerned with the desperately unhappy lives of common men.

Yet, strangely enough, this poor unknown little wanderer was to upset that whole elaborate society. He wrote a book on the origins of government, 'The Social Contract', teaching that no laws are binding unless agreed upon by the people. This so deeply affected French thinking that it became one of the chief forces that brought on the French Revolution. The revolutionary cry of "Liberty, Equality, and Fraternity" was an echo of Rousseau's teachings.

An Influence on Modern Education

Less violent but no less important was the revolution which he helped bring about in education. In his book 'Émile' he assailed the prevailing mode of education, in which children were schooled with little or no regard for their physical development or for their mental capacities. He attacked the system of treating children like machines, and urged that they be given much freedom and opportunity to enjoy sunlight, exercise, and play. Rousseau recognized that there are definite periods of development in a child's life and urged that the capacities for motor activity, observation, sense perception, and reasoning should be fostered only as the child felt the need. A child allowed to mature in this fashion would naturally and easily achieve his best possible development. Education should begin in the home. Parents should not preach to the child but should set him a good example. Rousseau believed that children should make their own decisions. Modern education has been widely influenced by some of these ideas (*see* Education).

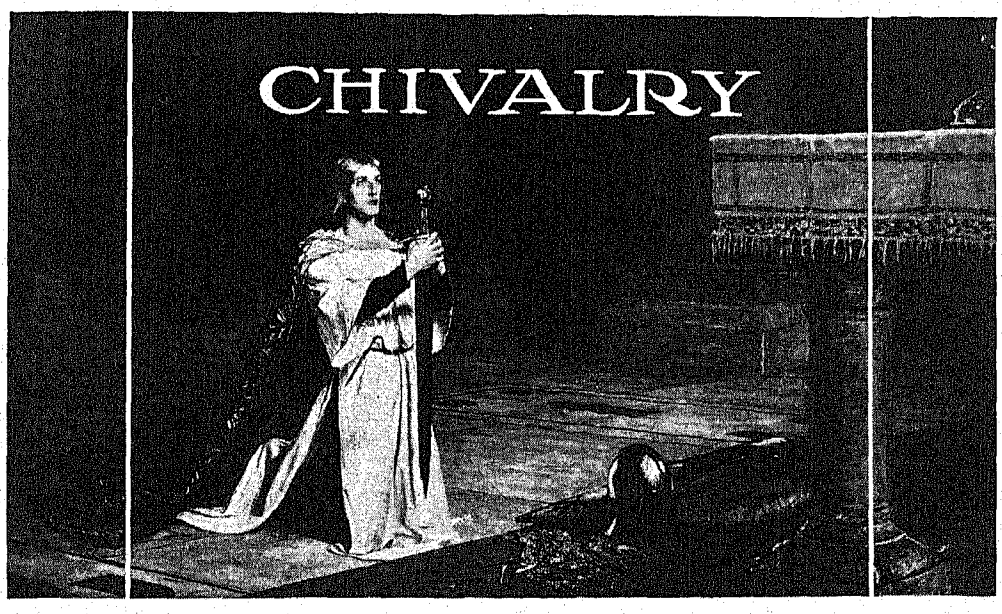
In literature, too, Rousseau inspired a profound change not only in France, but also in Germany and England. He stirred writers to realize that the beauties of nature had a rightful place in literature. He dared to voice his most intimate emotions. His autobiographical 'Confessions' is considered a masterpiece of candid self-revelation. So many writers followed his example that Rousseau is called the father of the romantic movement in literature.

Persecuted for his religious views, Rousseau fled the country in 1762. For a time he lived with the historian Hume in England. He later returned to France, broken in health and spirit. He died near Paris, a prey to unhappy delusions.

Careful readers of Rousseau find many flaws in his logic, especially in his greatest book, 'The Social Contract'. But it must be remembered that he lived in the 18th century, when the study of government was not the science it is today. And Rousseau had a large enough mind to realize that his was not the final word on government. "I ought throughout to have kept to a more limited sphere," he admits at the close of his book. Still, this genius was perhaps the most eloquent of all prophets of modern democracy, and some of his precepts helped to guide the founders of American democracy.

Rousseau's chief works are: 'La Nouvelle Héloïse' (The New Héloïse), 1761; 'Le Contrat Social' (The Social Contract), 1762; 'Émile', 1762; and his 'Confessions' (an autobiography, written between 1766 and 1770, published in 1782 and 1789).

CHIVALRY



ONE thing every boy must have if he would be a man indeed. One thing every girl must have if she would truly be a woman. That one thing is chivalry.

There may or may not have been a King Arthur with his Round Table, but all through this world there have been men, and women too, like him. They shine sometimes in history like bright stars in the sky. But mostly history misses them, and they belong to that unnumbered race of those who come into this world and live unselfish lives, and do great things in countless little ways, and pass unknown save by the few who never cease to mourn them. They are the chivalrous, the members of that mighty Table Round to which all heroic souls belong. They do not ride in gallant company to tournaments; their deeds are not cried out to all the world; but through their lives they sow the seeds of chivalry not less than did King Arthur's knights.

For chivalry is within the reach of all. The noblest possession of man, we can wake up, whether rich or poor, and possess it every morning. It was said of a great Roman that the elements so mixed in him—

> . . . . that Nature might stand up
> And say to all the world, "This was a man!"

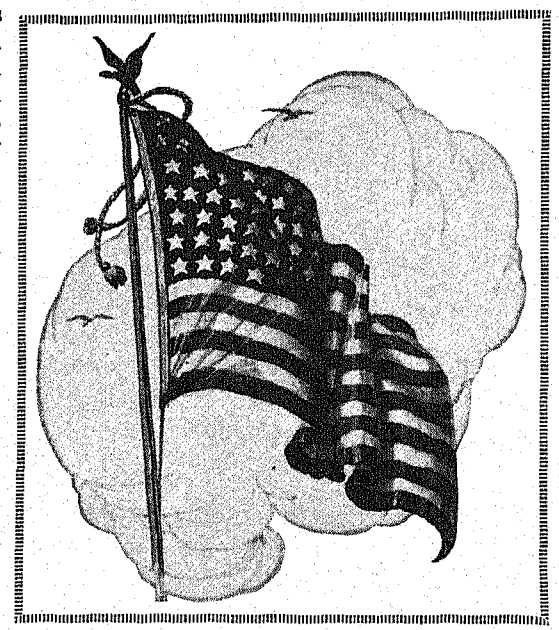
And we may say of chivalry that the virtues so mix in it that Virtue might stand up and say, "This is the noblest virtue of them all."

Chivalry has in it the love of courtesy, the courage that never quails, the will to suffer pain for others, the zeal that wears life out in great causes, a boundless pity for the poor, a burning passion to right a wrong, the scorn of scorns for cruelty, and the heart of hearts for all that is generous and helpful and noble and true. A fine equipment for the battle of life is this quality of heroes, the blending of all other virtues in this matchless one.

You are never afraid of a chivalrous man. You may trust him in all times and places; you may leave everything you have in his hands. He would not do you wrong; he would not lie to you; he would die first. There was a Red Indian who made himself chief of a tribe against the tribe's will, but they had to submit because the chief had the help of American soldiers. But the tribe made up its mind in secret that if ever the chief was false to his duty he should pay the price of his falseness. They arranged with a young Sioux named Crowdog that if such a time should come the chief should be killed; and Crowdog took the vow to kill him.

The time did come, and Crowdog killed the false chief. The United States government sentenced him to death and a few days before he was to die Crowdog asked for leave

to visit his wife and his two little boys. There was something fine about the men who had charge of him, and they trusted the man they had sentenced to death. They let him go home. He went home and kissed his wife and their two little boys, and then he went back to die. He was as chivalrous as the men who had trusted him; he would lose his life rather than his honor. But it is good to be able to say that he kept them both, for the story of Crowdog was told in the American papers, and it touched the great heart of the people. The story of the vow came out, and Crowdog was pardoned.



There is a story of another man who went back to die, and who did give up his life. It was Regulus in the days of Rome, when Carthage where he was a prisoner sent him to counsel his country to a dishonorable peace. He went to Rome, but urged his country *not* to make peace; and then he went back to his captors and paid for his courageous counsel with his life. There was no reason at all why Regulus should die—save that he could not love his life, "loved he not honor more." He had given his word; he would not break it. Do you remember the general in the American Revolution to whom a British officer offered a bribe of $50,000? "Gentlemen, I am poor," he said; "but your king is not rich enough to buy me." Never yet has king been rich enough to buy an honest man, and never yet has chivalry been bought. It is free wherever the sun shines, but millions of dollars cannot buy it.

Chivalry is what Tennyson says of it, in that great speech he made King Arthur say to Guinevere when he recalled to her the founding of his Table Round:

> A glorious company, the flower of men,
> To serve as model for the mighty world,
> And be the fair beginning of a time,

He made them lay their hands in his and swear to reverence the king—

> . . . . as if he were
> Their conscience, and their conscience as their king;
> To break the heathen and uphold the Christ;
> To ride abroad redressing human wrongs;
> To speak no slander, no, nor listen to it;
> To honour his own word as if his God's.

And then he urged them to live sweet lives of noble deeds, with that pure love which is the most subtle master under heaven—

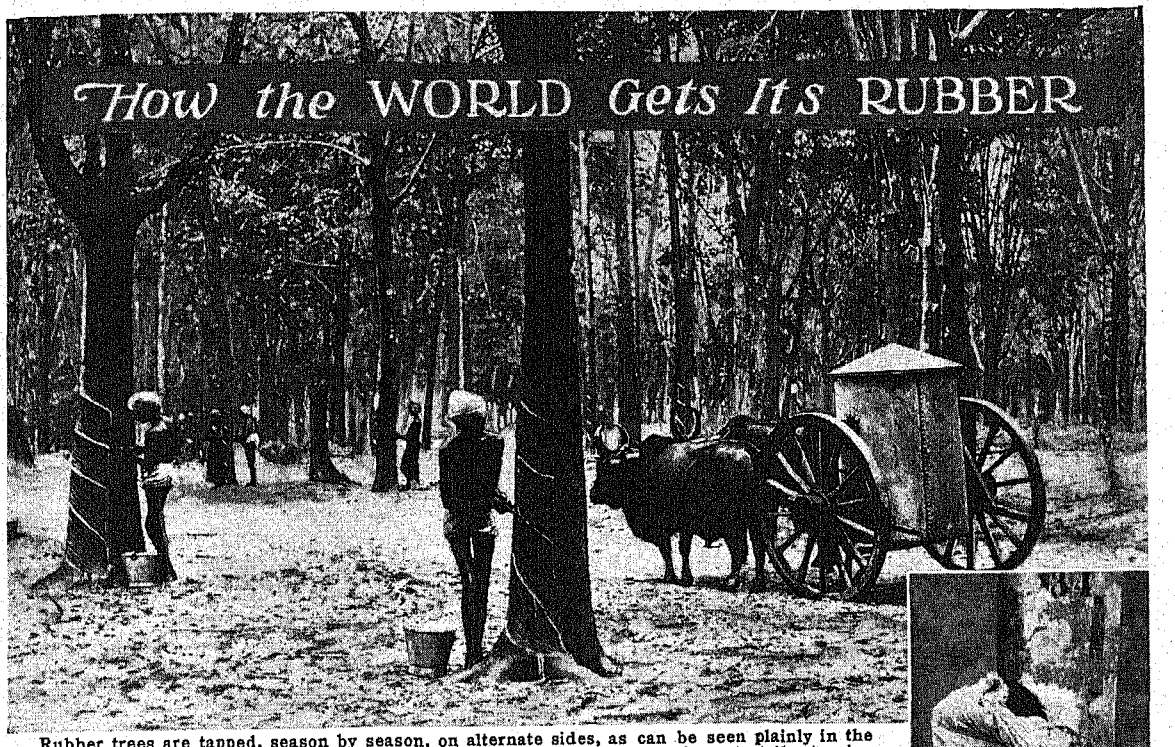
> Not only to keep down the base in man,
> But teach high thought, and amiable words,
> And courtliness, and the desire of fame,
> And love of truth, and all that makes a man.

Can you think of the manhood and the womanhood of the world made up of noble qualities like that? Things that break our hearts would pass away, and earth would be like heaven.

Through all the years that lie behind us our flag has stood for chivalry. It has caught in its folds the spirit of all that is best in the lives of the people. Braving the winds at sea, it has caught up the dauntlessness of men like Washington; flying over battlefields, it has caught the glow of men like Abraham Lincoln. It has shared the adventures, the thrills of pride and terror, of those who have gone out to explore new lands as Peary did; or of those who laid themselves down to die for others, as Private John R. Kissinger did in the great campaign for conquering yellow fever. Chivalry has captured the hearts of men everywhere. It is the secret of the British Empire; it is the secret of the United States and of enduring nations everywhere. It was the secret of the American and Allied armies in the World War. All the world saw then supreme examples of chivalry among great hosts of men who gave their lives for liberty.

It is for us to see that this spirit lives on, that we cherish justice to all and carry peace throughout the world. The acts of our lives make up the nation, and nothing that we do is quite without its influence in the world. Let us bear ourselves to all with courtesy and honor and goodwill; let us be ready to forget ourselves; let us suffer loss cheerfully if it must be. More than this have others borne for us, and we must not be outdone in good and noble things. We must keep burning, through whatever dark days may be, the precious lamp of chivalry.

How the WORLD Gets Its RUBBER



Rubber trees are tapped, season by season, on alternate sides, as can be seen plainly in the picture above. Here in the Straits Settlements, Malay Peninsula, the natives start the tapping about five feet above the ground. Each day a bit of bark is cut away until at the end of the season the base is reached. The next season new bark grows on this side while the other side is tapped. At the right is shown another method of tapping. The native tapper is cutting away a small strip of bark to make the latex flow.

RUBBER. In a world of hard steel and high speeds rubber is essential as a shock absorber. Industry and transportation would be paralyzed without it. When Japan in the second World War cut off the American supply of natural rubber, synthetic substitutes had to be developed rapidly on a tremendous scale.

The United States makes more rubber goods than all the rest of the world combined. In a normal year its factories turn out about 100 million automobile tires and about 360 million pairs of rubber heels. And these are only two out of more than fifty thousand uses. They require annually more than one billion pounds of raw rubber. Yet a century ago rubber was considered little more than a curiosity.

The History of Rubber

Rubber was named by the learned Dr. Joseph Priestley of England, the discoverer of oxygen. In 1770, a friend in America sent him a ball of crude rubber. Discovering that it would rub out pencil marks, he broke off small pieces and called them "rubbers."

Until recently it was believed that Columbus was the first European to see rubber. Late researches indicate that rubber did not grow on any of the islands visited by Columbus, and the honor is now given to the Spanish explorers in Mexico. These early explorers reported that the Indians played a game with a bouncing ball made from the dried gum of a tree which they called *caoutchouc*, or "weeping tree," because it gave forth a juice so freely that it seemed to be shedding tears. Caoutchouc hence became the common word for rubber in nearly every language except English. A few years later, the soldiers of Pizarro learned from Peruvian natives to cover footwear and clothing with this waterproof juice.

Though some of the properties of this marvelous gift of nature were known 400 years ago, it was of little importance until the 19th century. In 1818, James Syme, a brilliant 19-year-old medical student who later became professor of surgery at Edinburgh University, found that coal-tar naphtha would dissolve the dried gum, and that cloth could be waterproofed by pressing thin sheets of the dissolved gum between two pieces of fabric. Charles Macintosh, a manufacturing chemist of Edinburgh, patented Syme's

process in 1823, and made waterproof garments, which were commonly called "mackintoshes."

Pure rubber, however, gets soft, sticky, and disagreeably odorous in warm weather, while cold makes it brittle. Articles made from it were unsatisfactory, until *vulcanization* was discovered in 1839 by Charles Goodyear, a Connecticut hardware merchant.

The Discovery of Vulcanization

Goodyear got the idea that the defects of rubber might be overcome by processing it with some other substance. In his search for the right substance he became so engrossed that he let his hardware business go to pieces and was even jailed for debt. Success came at last partly through accident, when he was displaying a mixture of rubber and sulphur. The piece slipped from his hand into the fire, and when he took it out he found to his amazement that the mass had charred without melting. It was not sticky, and when it was stretched it snapped back into its original shape. He nailed it to the doorpost, and in the morning found that the frost had not made it brittle.

Goodyear named this process of combining rubber with sulphur by heat "vulcanization" (from Vulcan, the god of fire). Later he discovered that the addition of zinc oxide made the compound stronger and tougher, and that vulcanization could be speeded by adding lime, magnesia, and lead compounds.

In 1844 Goodyear secured patents for his discovery, and thereafter was often in court fighting for his rights. In one suit he was defended by Daniel Webster and opposed by Rufus Choate, two of America's most famous statesmen. Goodyear received medals at the London Crystal Palace Exposition of 1851 and at the Paris fair of 1855. Financial success, however, did not come; vulcanizing projects which he launched in England and France failed, and he was jailed for debt in Paris. But before his death in New York in 1860, he saw his invention put to some 500 uses and give employment to 60,000 persons.

Goodyear is entitled to all credit for his great discovery. We must not get the idea, however, that he left vulcanization a perfected process. Thousands of research workers have been working and are still working to improve vulcanization methods, since all the factors are capable of enormous modification and variation, including the quality of the rubber, the proportion of sulphur, the use of thousands of accessory compounding agents, and the time and temperature of the vulcanization process. As little as 1 per cent of sulphur may go into thin, elastic goods, and as much as 50 per cent is used in hard rubber. Rubber can be made softer than a sponge, lighter than cork, or as hard as ivory.

Latex—the Raw Material of Rubber

Crude rubber is made from the *latex* or milky juice of certain trees and smaller plants. A good idea of the nature of rubber latex can be obtained by examining the sticky liquids that flow from the broken stems of dandelions or milkweeds. Indeed, inferior kinds of rubber could be made from them. The so-called rubber plant (*Ficus elastica*) so common in our homes yields a latex very closely resembling that of the commercial rubber trees. Other forms of latex are the plant juices that yield gutta-percha, balata, and the chicle for chewing gum (*see* Gutta-Percha; Chewing Gum).

The best-known source of rubber latex is the tree called *Hevea brasiliensis*. The latex is not the ordinary sap of the tree, but is secreted in a network of passages in the soft inner bark, just outside the inner skin (cambium) which covers the wood of the tree. When the tree is wounded, the latex oozes out, hardens in the air, and so closes the wound.

As it comes from the tree, the latex is a complex mixture of water, proteins, fatty acids, mineral salts, and sugars, in which are suspended myriads of tiny pear-shaped particles of the rubber substance. The mixture is of the type called a colloid (*see* Colloids).

The rubber particles make up about one-third of the latex. Under the microscope most of them are shown to be less than one ten-thousandth of an inch in length. They resemble tiny sacks, with a tough outer covering enclosing the rubber fluid. The first step in rubber making as described on the next page is to separate these particles from the other ingredients of the latex mixture.

Tropical Rubber Plantations

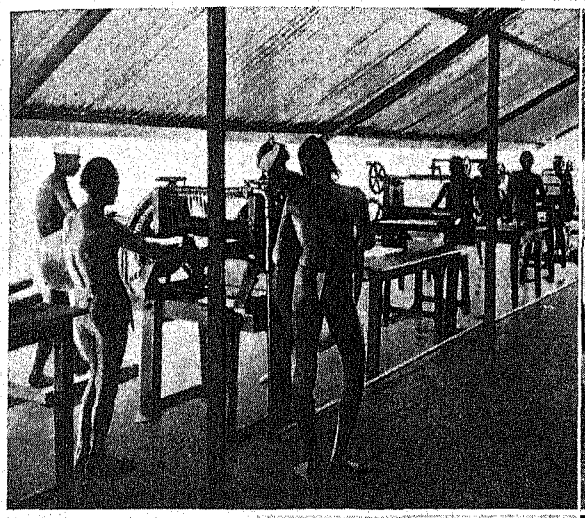
Until the early part of the present century, nearly all commercial supplies of rubber came from the forests of the Amazon in South America and the Congo in Africa. Now about four-fifths of the supply of natural rubber comes from plantations in British Malaya near Singapore, and from the Netherlands Indies. The rest comes from Indo-China, Ceylon, Thailand (Siam), Sarawak, Brazil, Burma, Liberia, and the Philippine Islands.

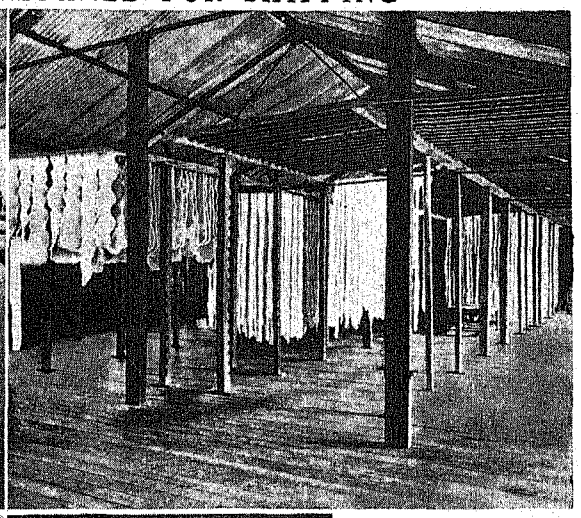
The plantation rubber industry of the Far East is the result of the work of Henry Wickham (later Sir Henry Wickham), an English botanist, who spent years in Brazilian jungles studying the rubber tree. British officials commissioned him to gather seeds for experimental planting at the famous Royal Botanical Gardens at Kew, England. Wickham took an ocean-going vessel far up the Amazon River, and placed on board 70,000 rubber-tree seeds. They had to be gathered and stored under most careful supervision, since their oily covering would lose its vitality unless exactly right conditions were maintained. In 1876 seeds from the Botanical Gardens were sent to Ceylon, and after prospering there were planted in Malaya, Sumatra, Java, and Borneo.

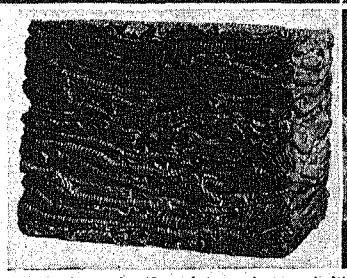
The plantation industry, however, developed slowly until the Brazilians attempted, in 1905 and later, to "corner" the rubber supply and sent prices soaring, first to $1.50 a pound and later to $3.06. The extraordinary profits reaped by the few British plantations then in bearing gave tremendous impetus to the industry, and by 1915 some 3,000,000 acres had been planted in the Far East.

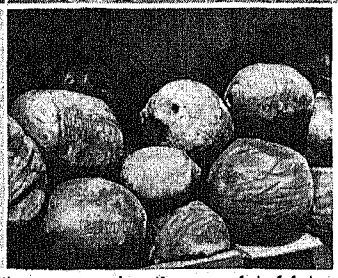
In 1922 British plantations supplied 75 per cent of the world's rubber. Today they supply little more

HOW THE RUBBER IS PREPARED FOR SHIPPING









The natives in the picture (upper left) are squeezing the coagulated latex between corrugated iron rolls, which revolve at unequal speeds. A stream of water washes the rubber as it goes through the rolls. To remove the 20 per cent of water left in the crêpe rubber as it comes from these machines, the sheets are hung on poles in the drying room (upper right) for about three weeks. The rubber is then packed in bales like the one shown at *the lower left and is ready for shipment.* At the lower right is shown the balls or "hams" of rubber prepared by the old South American method of dipping and smoking the latex on a wooden paddle.

than one-half. This decline is partly due to their attempt, by the Stevenson Act, to limit production and so increase the price of rubber during the years 1922–28. The Dutch took advantage of the restriction on British production to increase their own, and today Dutch plantations supply about a third of the world's rubber. After 1928, when the British resumed full production, the supply became so great that its price fell to 3 cents a pound in 1932 and 1933. The chief rubber growers of the world faced ruin; so they made an international agreement to limit the production and export of rubber in the Far East.

American capital supports several large rubber-producing areas, such as Harvey S. Firestone's plantation in Liberia, the United States Rubber Company's plantations in Sumatra and Malaya, and Henry Ford's vast concession in Brazil. To develop a plantation takes time and money, for a tree planted from seed cannot be tapped for five years and it is ten years before it reaches full production.

How Rubber Is Collected

On rubber plantations, the standard method of collecting rubber latex is as follows: A spiral cut about a quarter of an inch wide is made in the bark about four and a half feet from the ground; or a straight-down cut is made with diagonal cuts running into it—the "herring-bone" method. This cut must be made with great care, or the tender inner covering protecting the wood will be punctured and the tree will die. A cup is fastened below the cut. A few drops of ammonia, formalin, or soda are put in, to keep the latex from hardening. When the flow ceases, more bark is shaved to permit more juice to flow.

Latex oozes very slowly, at first two drops a second, and at the end of an hour, a drop a minute. Each tapping yields about one fluid ounce, which makes one-third of an ounce of raw rubber. Formerly the average annual yield of a tree was only 4 or 5 pounds of latex, but this is being increased by selection of high-yielding trees and bud grafting from them. The best trees produce 20 to 30 pounds a year.

Natives collect the latex from the cups and pour it into flat pans. The rubber is separated from the rest of the latex usually by adding acetic acid, which causes the rubber particles to clot or coagulate and rise to the surface in the form of a thick sheet. Iron rolls squeeze out the liquid from these sheets. In preparing *crêpe*—a large thin crinkly sheet—the rolls revolve at unequal speeds, and the sheets are hung up to dry for about three weeks. For *smoked sheet*, usually prepared in sheets thicker than crêpe, the rolls revolve at equal speed, and the pieces are dried by smoking for 10 to 14 days.

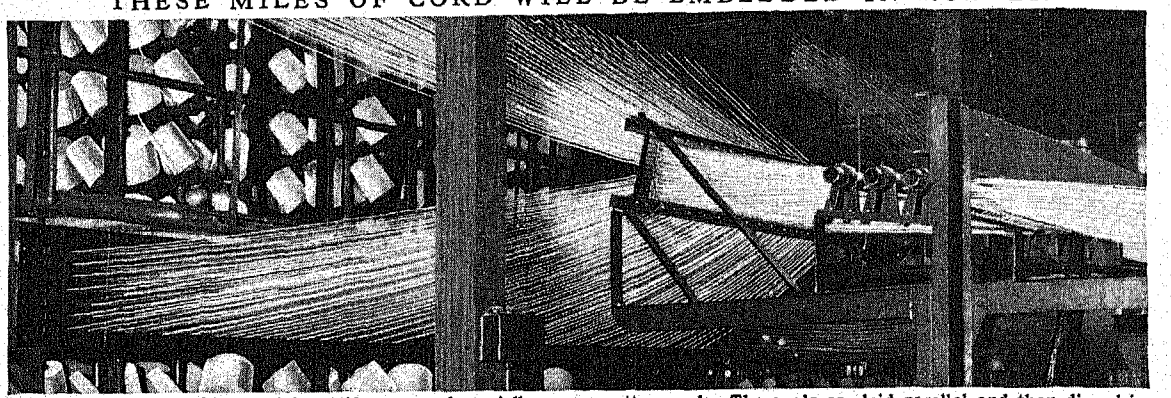
In recent years, tank ships have brought great quantities of liquid latex to the United States. This latex has been made into "sprayed rubber," by letting the latex fall on top of a polished steel disk revolving at great speed in the top of a chamber heated to about 350° F. Centrifugal force throws the latex in tiny

particles from the edge of the disk, the heat hardens the particles instantly, and they sift like snow to trays in the bottom of the chamber. One machine can produce a spongy mass of 600 pounds of rubber in an hour. In another process, a thin layer of latex is formed on the inside of a rotating drum. Warm air, blowing on it, evaporates the water. More latex is added until a layer of the required thickness is formed; then the rubber is cut off in sheets.

Before the automobile became common, the world used only about 60,000 long tons (2,240 pounds to the ton) of rubber every year. Today, as many as 1,000,000 long tons may be used in a single year, of which the United States imports about one-half.

The center of the rubber industry of the United States is the city of Akron, Ohio, "America's rubber capital" (*see* Akron, Ohio). At the factories crude rubber, with reclaimed rubber often added, is torn

THESE MILES OF CORD WILL BE EMBEDDED IN RUBBER



This complicated machine contains 3,400 cones of specially woven cotton cord. The cords are laid parallel and then dipped in latex, to be later sandwiched between two layers of rubber "skim-coating" to form one ply of a finished automobile tire. Each of the 3,400 cones contains about nine miles of cord, every inch of which has to be coated with rubber.

Little rubber now comes from its original home in the Amazon jungles. There the natives collect the latex in the most primitive fashion. Each gatherer has a number of trees, between which he cuts paths. Early in the morning he taps the trees and attaches cups. When all the trees have been tapped, he begins collecting the latex into a rubberized cloth bag on his back. Then in his palm-thatched hut he builds a fire in a pit covered with clay, which has an opening for the smoke to escape. Using a little latex that has coagulated naturally overnight, he starts a ball on a pole above the smoke. He keeps pouring latex over the ball and rolls it slowly over and over through the smoke until he has a ball or "ham" that weighs 10 to 20 pounds. Sometimes one day's gathering of latex is smoked on a square paddle. Belem, in the state of Pará, Brazil, used to be the great rubber port of South America and the best grade of rubber was known as Pará rubber.

Tires and rubber tubes are today the principal products of the rubber industry. About 75 per cent of all rubber goes into them. Robert William Thompson of England was probably the first person to think of supporting a vehicle on tubes filled with compressed air. In 1845 he invented and patented a process of making pneumatic tires with a rubber tube protected by an outer casing, which was at first made of leather. A carriage tire of this type lasted for 1,200 miles. Over 40 years later, John Boyd Dunlop, a veterinary surgeon of Belfast, made a rubber tire for his son's tricycle, and patented the process in 1888. He began to manufacture bicycle tires in 1890.

and kneaded with water between two heavy iron rolls about six feet long. One moves faster than the other, and the two are set from one-fourth to three-eighths of an inch apart. When the rubber is soft and plastic, sulphur and accelerating agents are poured into it, and the milling continues until the compound is thoroughly mixed. Another machine, the internal mixer, has rolls which rotate in opposite directions in a closed compartment, to grind the rubber and compounds together, both between the rolls, and between the rolls and the walls of the compartment.

The next step is *calendering*. A calender consists of three hollow iron rolls, one above the other, with steam or water passing through the rolls to regulate the temperature. The calender may press the rubber into sheets of varying thickness, or lay a coat of rubber on different fabrics, or grind or "friction" the rubber into fabrics. In this last process, the upper roll, around which the rubber runs, moves faster than the lower roll, against which the cloth travels. The rubber is ground into the cloth between the lower rolls so that every thread is completely surrounded by a film of rubber. Cord tire carcasses sometimes are made from cotton cords run off on spools through a solution of latex so that every thread of every cord is thoroughly saturated with rubber.

The mixture for automobile tire treads contains carbon black, sometimes as much as 30 per cent. Carbon black gives toughness to the rubber and increases the mixture's resistance to abrasion. An automobile tire "casing" ordinarily is formed by stretching strips of frictioned or coated cord fabric, cut on the bias to

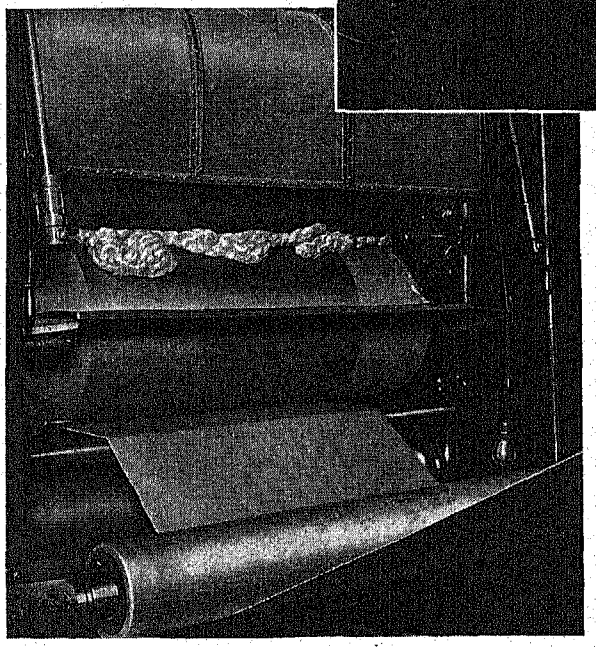
the proper width, around a core or a wide, flat drum. The beads which hold the tire to the rim, the thick tread, and the side walls are added, and then the tire is cured, or vulcanized, by heat, as shown in pictures on page 169.

Retreading, Inner Tubes, and Solid Tires

Insertion of the tread as a separate piece aids in reclaiming worn tires. When the tread is worn, it can be removed and replaced. It is taken off down to the breaker strip which separates it from the inner carcass of cord, and a new tread, called "camelback," is vulcanized on. A less effective process, called "recapping," consists of vulcanizing new rubber over the worn tread in a mold. If the cord carcass has suffered minor injuries, it can be strengthened with a heavy lining of rubber.

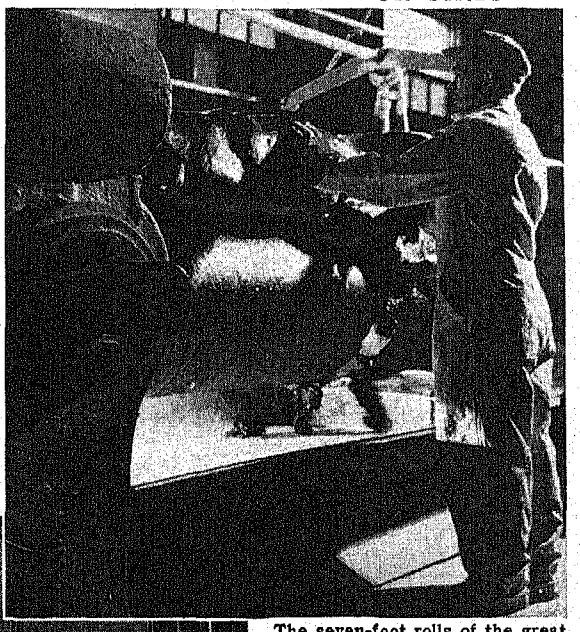
These salvage methods are used for all types of tires, but especially for the large, expensive types used on heavy trucks and tractors. In time of war these salvage methods become particularly important as a means of cutting down importation and use of new crude rubber.

Inner tubes are made by pressing compounded rubber through a mold to form a continuous tube that travels along a conveyor. While on this, the tube is automatically marked into the proper lengths for inner tubes and holes are punched in it for the valves. Next, the valve stems and bases are inserted. Then the tube is cut to proper lengths at the places indicated by the automatic marker. From the conveyor the tubes go to a splicing machine. This fastens the ends together by electrical and mechanical methods to form a joint which is smooth and airtight. Each tube is then vulcanized under pressure in a circular (watchcase) mold. The tubes are next inflated and then submerged in water to see if bubbles arise, indicating leaks. Airtight tubes are polished, deflated, and packed for shipment.



Solid tires are made on iron bases. These bases or rims are cleaned with blasts of sand, coated with a special rubber cement, and heated in an oven. While a base is still hot, it is mounted near a calender from which sheet rubber is rolled on the rotating rim and forced into grooves in the rim. Another calender rolls layers of the rough tread to the required thickness. A machine trims the rubber to the shape of the finished tire. It is vulcanized in a mold by steam, with very high hydraulic pressure forcing the rubber into the desired shape. Cushion tires are made of a softer rubber than solid tires, and hollows are formed in them while they are still in the molds,

PREPARING RUBBER FOR TIRES



The seven-foot rolls of the great mixer (above) tear and knead the rubber with the pigments and other materials. The millman occasionally cuts the rubber loose and feeds it back into the mill. At the left a skim-coating of rubber is being applied to the web cord fabric. The machine impregnates each cord of the fabric with rubber, and presses a thin sheet of rubber over both surfaces.

a process which gives them greater resiliency.

Vulcanizing methods differ for various articles. Such products as rubber heels, soles, water bottles, and bathing caps are cured in molds, like tires, by the "press cure." Rubber sponges are cured between steel plates, set apart to let the rubber expand. The expansion is caused by gas, generated by the heat of vulcanizing from bicarbonate of soda or some other "blowing" agent added to the rubber mixture. Rubber rings for jars, air-brake hose, and some boots and shoes are vulcanized by the "steam cure" in an iron cylinder in which steam acts directly on the articles. They are often shaped on metal forms and vulcanized wrapped in wet cloths. In the "air cure" process, articles which might be damaged by steam, such as woolen cloth in gaiters, are heated by warm air.

The "vapor cure" process is used for thin articles such as dress shields. In this process the mixture has no sulphur; it is cured by exposing it to a vapor of sulphur chloride. To make gloves, finger cots, and similar articles, porcelain forms are coated by dipping them into a solution of rubber in benzol. After it dries, the rubber coating is cured by dipping in carbon bisulphide, or in sulphur chloride solution.

Boots and shoes are shaped and vulcanized on perforated wooden or aluminum lasts. Cloth footwear can be given a hard waterproof varnish made of rubber, lampblack, and sulphur dissolved in turpentine. Garments can be given a rubber coating by running on several layers of rubber. Small rubber hose, channel rubber for automobile windows, and similar products are made in molding machines.

Making Hose, Tennis Balls, and Belting

Garden hose may be made by rolling a long stream of rubber on a rotating drum or disk, meanwhile supplying air pressure inside to keep the rubber a hollow tube. Then a braiding machine warps braided cotton around the tube, and this is coated with rubber. The braiding and coating are repeated to make as many plies as desired. In another process, the first tube is formed on a mandrel; then successive plies of fabric are wrapped around it and coated with rubber. The hose may be vulcanized in 20-foot sections in a press, or in long sections on a drum inside a cylinder. The heat is provided by hot water inside the hose, and steam outside.

To make a tennis ball, four segments of rubber are sewed together, with a small disk of pure rubber and a few drops of water inside. Then the ball is heated in a mold to cure it. The heat also changes the water to steam, which forces the ball tight against the mold. Next, compressed air is shot into the ball through a hollow needle, at the point where the disk is attached inside. When the needle is withdrawn, the disk expands and plugs the hole. Finally, the flannel covering is cemented on.

To make belting, rubber-impregnated ("frictioned") fabric is folded and rolled, two plies at a time, until the desired thickness is built up. Then the belting is cured in hydraulic presses.

Hard and Special Rubbers

Hard rubber contains a large amount of sulphur, usually 30 to 50 per cent. It is used in the chemical industries for vats and other containers because it resists attack by most chemicals. It is also used in rayon manufacture to prevent contamination by contact with metal. A tough rubber coating for vats can be deposited electrically from a solution of latex, sulphur, and carbon black.

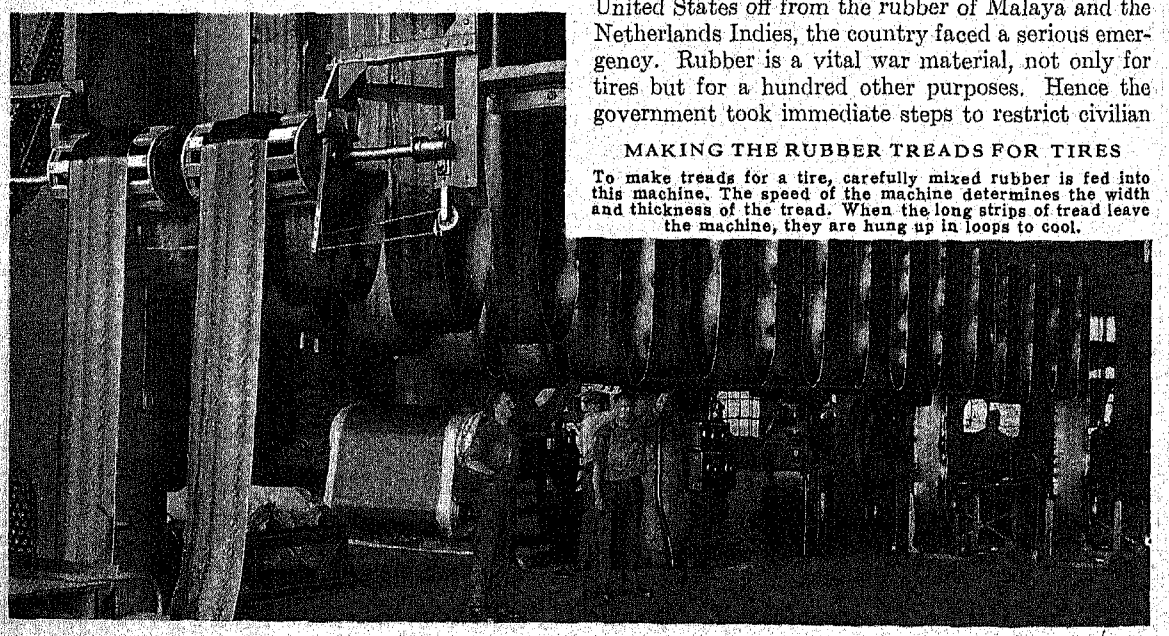
Colored rubbers are produced by adding pigments. For white rubber, zinc oxide, zinc sulphide, lithopone, or titanium oxide are used; for black, carbon black; for red, iron oxide; for yellow, zinc chromate; and for blue, ultramarine.

A rubber paint called *thermoprene* is made by dissolving rubber in gasoline or benzene. The transparent sheeting called *pliofilm* is rubber hydrochloride. *Lastex* is rubber thread wrapped with silk or other material. *Latex foam sponge*, used for cushions and mattresses, is made by whipping latex and certain chemicals into a foam, and then baking the mixture. Millions of tiny interconnecting cells permit free flow of air within the cushion under pressure.

Rubber is *reclaimed* by grinding scrap and removing impurities with chemicals. Reclaimed rubber is less elastic than new rubber, but it has many uses.

Meeting Shortages Caused by War

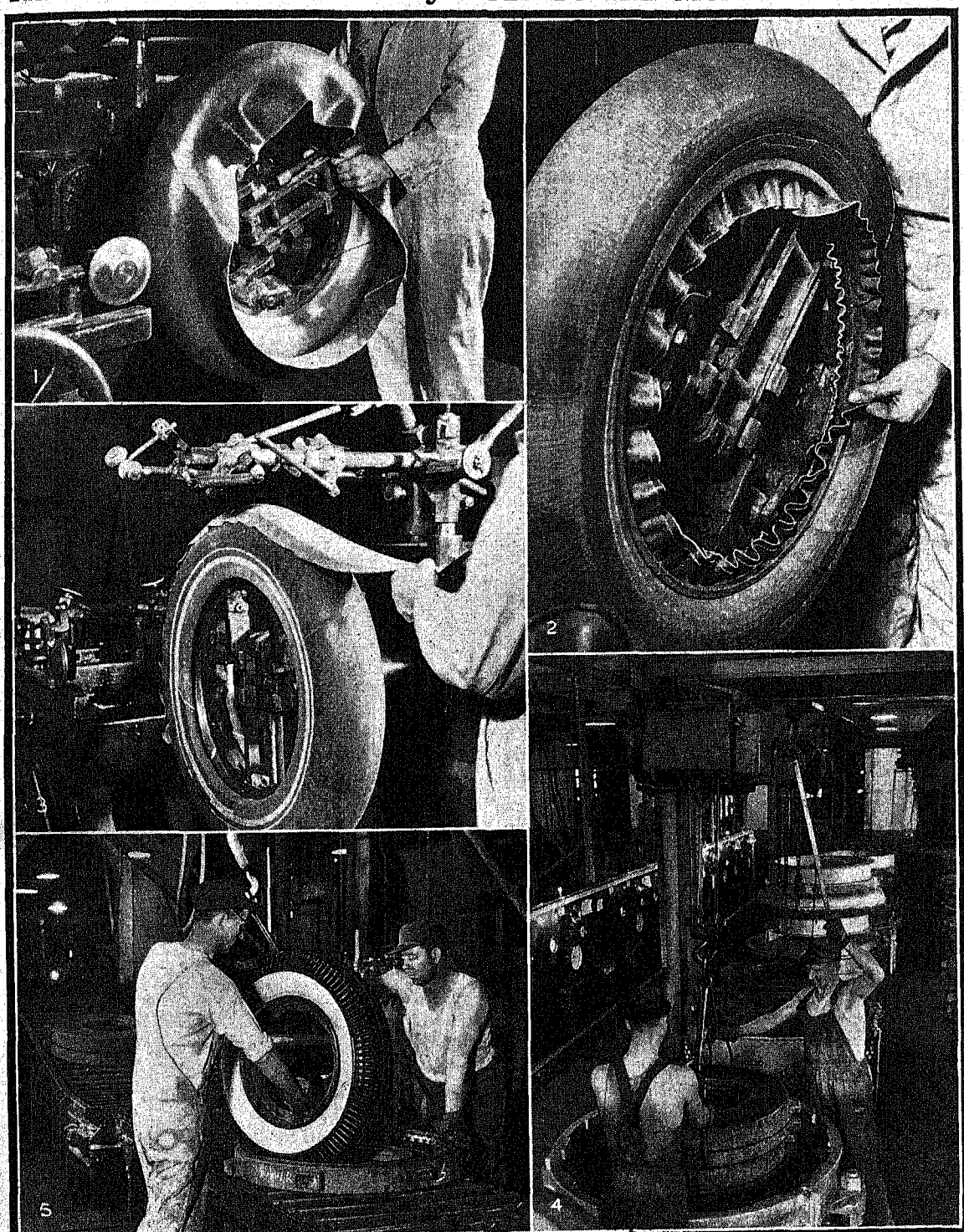
When the Japanese attack in 1941 and 1942 cut the United States off from the rubber of Malaya and the Netherlands Indies, the country faced a serious emergency. Rubber is a vital war material, not only for tires but for a hundred other purposes. Hence the government took immediate steps to restrict civilian



MAKING THE RUBBER TREADS FOR TIRES

To make treads for a tire, carefully mixed rubber is fed into this machine. The speed of the machine determines the width and thickness of the tread. When the long strips of tread leave the machine, they are hung up in loops to cool.

THE LAST STEPS FROM THE JUNGLE TO THE MODERN HIGHWAY



1. The cord fabric is cut into bias strips, to give strength, and these strips are applied over an iron core. 2. After several plies are put on, the bead is set in position and locked into position by folding the plies back over it. 3. Next, a breaker strip, mounted on gum rubber, is applied to form a foundation for the tread, which is put in place immediately afterward. The side wall is then applied and the tire is ready for curing. The core on which it is made is removed and the tire is inserted in an iron mold. A rubber air bag is placed inside and steel rings are locked into place to form the correct bead. 4. The mold is lowered into the vulcanizer, where a hydraulic press holds the two halves of the mold together. 5. The completed tire, after a cure of from one to five hours, is being taken from the mold. Here the air bag and the bead rings are removed and the tire is ready for inspection, balancing to find the proper place for the valve when the tire is mounted on its rim, and finally for wrapping in a machine which winds a continuous strip of tough paper about the tire. It is then shipped to the dealer.

consumption and conserve the existing supply. There were 600,000 tons of raw rubber in reserve—about enough for a year of peacetime uses. But at least 400,000 tons a year were needed for war equipment. Thus, by cutting civilian use to the bone, the United States had rubber enough to last for twelve months. Thereafter all needs would have to be met from new sources of supply.

The government worked with Latin American countries to revive their rubber production. It also sought to cultivate in the United States plants that yield a latex similar to that of the rubber trees. One of these is a species of goldenrod. Another is a Russian dandelion, the *kok-saghyz*. The most productive was the guayule shrub, a native of Mexico which can be grown from Texas to California (*see* Guayule). These developments, however, would take two years or more. Meanwhile shortages would have to be made up by the manufacture of synthetic rubber-like materials.

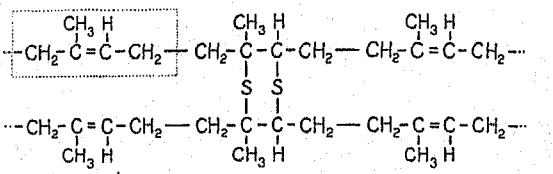
What Is Synthetic Rubber?

For many years chemists had been trying to make substitutes for natural rubber. This might appear easy, since raw rubber is composed of only two common elements—carbon and hydrogen (5 parts of carbon to 8 parts of hydrogen). But the units of these elements had to be linked together in a very special pattern to produce rubber. This proved so difficult that many chemists stopped trying to make exact duplicates of natural rubber. Instead they tried to find other chemical combinations that would provide the same physical qualities as rubber. Scores of such rubber substitutes (butyl rubber, buna rubbers, neoprene, etc.) were actually discovered. No single one has *all* the qualities of natural rubber, but some of them are actually better for certain purposes.

Although these substances are generally known as "synthetic rubbers," chemists prefer to call them "rubber substitutes." A true synthetic rubber would be an exact duplicate of natural rubber. To make these substitutes, chemists do not begin with plain carbon and hydrogen. They start with materials in which desirable combinations of carbon and hydrogen already exist. Among them are acetylene, alcohol, and certain compounds derived from petroleum. Usually, these raw materials cannot be turned directly into rubber-like substances, but must first be made into intermediate forms. Among the latter is the chemical called butadiene, so widely discussed in connection with the American synthetic rubber program.

Principles of Rubber Chemistry

Making any rubber substitute is a highly technical process, but students who have had some training in chemistry can grasp the general principles involved. Natural rubber consists principally of a hydrocarbon called *isoprene* (C_5H_8). Molecules of this chemical are joined to each other in long chains, each chain forming a large molecule or *polymer* composed of a number of identical smaller molecules. A number of these chains, in turn, are intertwined forming the pear-shaped clumps or particles earlier described as part of the rubber latex. Raw rubber consists of these particles alone, with the surrounding liquid removed. When rubber is vulcanized, atoms of sulphur form cross-links between the isoprene chains, building up still larger molecules, and, because of the cross-linkages, making the rubber mass cling together more firmly. The structure of isoprene, the chain formation, and the nature of the cross-links are indicated in the following diagram:



A unit molecule (monomer) of isoprene is set off by dotted lines. Three units form the chain molecule (polymer) at the top. A similar chain is shown at the bottom. Forming a cross-link between the middle units of the two chains are two sulphur atoms introduced by vulcanizing. If all the units were linked by sulphur atoms, the diagram would illustrate completely vulcanized or "hard" rubber.

Chemists have long known how to make simple (monomeric) isoprene out of turpentine, but they were unable to get their synthetic isoprene to form into chains (polymerize). And without the chain formation, it lacks rubber-like properties. So they began experimenting with other synthetic materials more or less closely resembling isoprene.

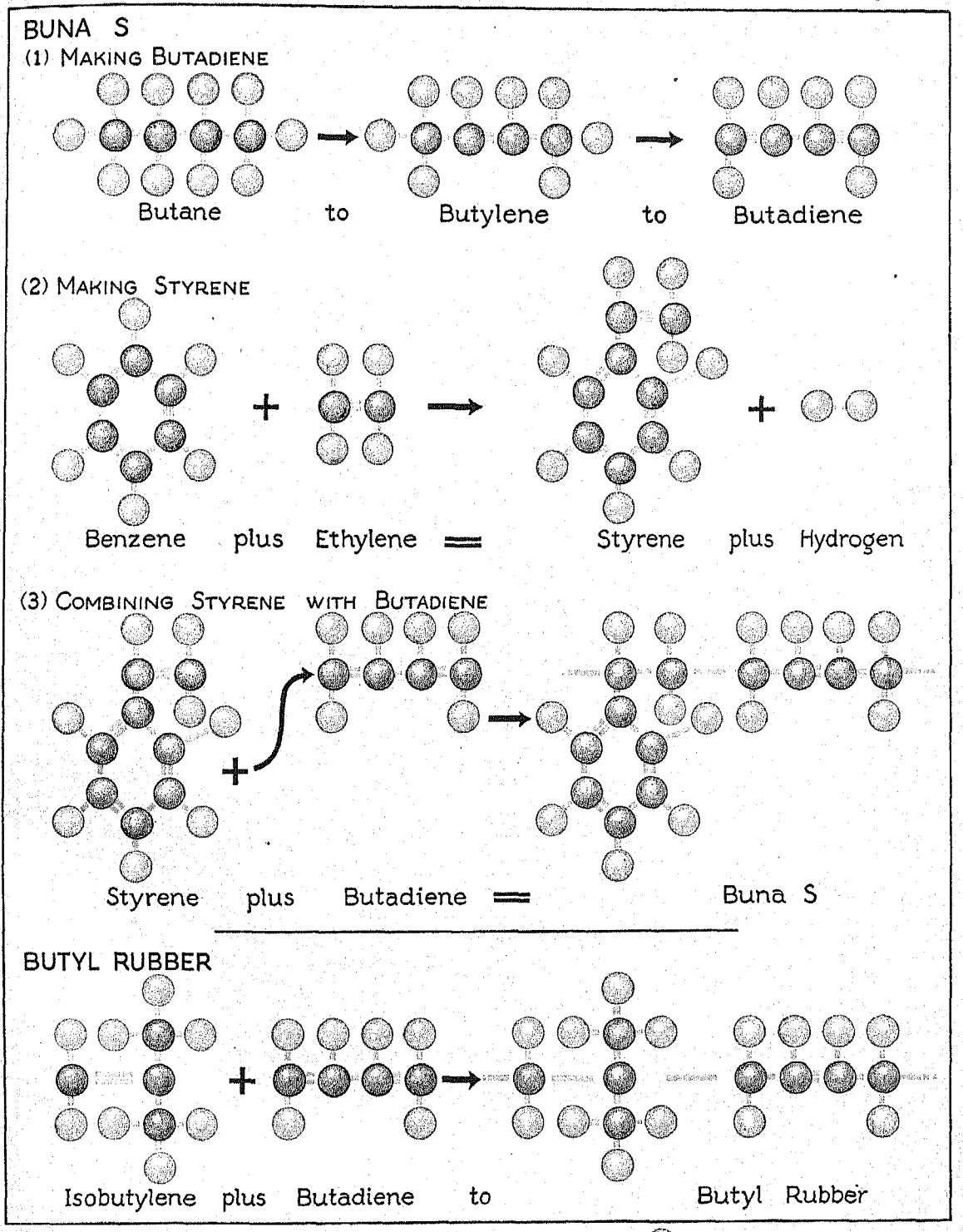
First Steps toward Success

In 1925 the Rev. Dr. Julius Nieuwland of Notre Dame University, while experimenting with acetylene, produced a substance called *vinyl-acetylene* that aroused the interest of the research chemists of the Du Pont laboratories. Working with Dr. Nieuwland, they produced from this substance another material called *chloroprene*. It proved possible to combine chloroprene molecules into chains and to vulcanize them by heat alone into a kind of soft rubber that was given the trade name of "neoprene." The structure of chloroprene is identical with the *butadiene* illustrated on the opposite page, except that one of the hydrogen atoms in the middle of the structure is replaced by an atom of chlorine.

Butadiene itself soon became the center of experiments by German chemists. They found that, like chloroprene, it would polymerize into a rubber-like material. But they discovered also that much better rubber resulted if molecules of certain other substances were introduced as links in the butadiene chains. When molecules of two different chemicals thus take part in forming a chain, they are said to *copolymerize* and the product is called a *copolymer*.

The Germans made a copolymer of butadiene and *acrylonitrile* called perbunan or buna N. This vulcanized with sulphur just as natural rubber does, and was very resistant to the attack of oils, but was not deemed suitable for automobile tires. More successful in this respect was the copolymer of butadiene and *styrene*, called buna S. Chemical steps in making this substance are shown at the right.

CHEMISTRY OF BUNA AND BUTYL RUBBERS



Three steps in the making of buna S are illustrated. In the first of these, the butane (from petroleum) is turned into butadiene by cracking, that is, removing hydrogen atoms. If the butadiene were made from ethyl alcohol, this first step would show two molecules of alcohol ($2CH_5OH$) combining directly to form one molecule of butadiene, two of water ($2H_2O$), and one of hydrogen (H_2). The other two steps would be the same. All the chemical reactions shown here, both for buna and butyl rubber, are brought about by the action of catalysts (*see* Chemistry).

Hydrogen atom
Carbon atom
Double Valence Bond

Shortly after the formula of buna N became known, similar rubbers, improved in quality, were developed in the United States under various names, including Chemigum, Ameripol, and Hycar. At the same time, general research in the field of synthetic plastics yielded a great number of substances of widely differing chemical structure, but possessing some of the properties of rubber (*see* Plastics). Among these were Thiokol, Koroseal, and Vinylite.

In 1940 the Standard Oil Company of New Jersey announced the discovery of *butyl rubber*. This is made from *isobutylene*, a by-product of petroleum refining, copolymerized with a small amount (about 2 per cent) of butadiene. Previously a substance called Vistanex had been made by polymerizing isobutylene alone. But this could not be vulcanized. The addition of butadiene contributed to the polymer chain the unused chemical bonds to which the vulcanizing sulphur could attach itself. The structure of butyl rubber with the double bond in place is shown in the diagram at the bottom of the preceding page.

The best of these synthetic rubbers were superior to natural rubber in several respects. In general they were more resistant to the degrading effects of heat and aging. Some resisted oils and chemicals better than natural rubber. Some stood wear as well or better. None had quite as much "bounce" as natural rubber. Nevertheless, they could together serve all the purposes for which natural rubber had been used.

A Problem of Mass Production

The question then was not one of quality but of quantity. Could enough synthetic rubber be produced to meet the immediate demands of the nation at war? The government's program centered on buna S for tire casings, butyl rubber for inner tubes and similar purposes, and neoprene for hoses, tank linings, and other articles that must resist corrosion.

The final steps in the manufacture of these rubbers did not present so great an engineering problem as did the creation of a large enough supply of the raw materials from which they are made. The chief ingredients for butyl rubber and for neoprene could be obtained in fairly large quantities through existing facilities, but to produce the vast amounts of butadiene called for by the wartime program required new plants and new equipment on a very large scale. This substance, which is a gas at ordinary temperatures, can be efficiently made either from alcohol or from petroleum. In the emergency, both methods had to be used to the utmost to meet the demand (*see* Nation at War).

RUBENS, PETER PAUL (1577–1640). "Ah! His Majesty's ambassador occasionally amuses himself with painting!" So exclaimed a courtier of the English King Charles I, surprised to discover the Spanish envoy to England, Peter Paul Rubens, before an easel in his rooms in Whitehall Palace.

"On the contrary," replied Rubens, "the painter occasionally amuses himself with diplomacy!"

Today we think of Rubens only as the greatest of all Flemish painters, but 300 years ago he was nearly as famous a diplomat as artist. He painted masterly pictures of and for crowned heads of Europe; but he was equally skilful in managing delicate affairs of state. Not only was he the master artist of his day, who had learned all that others could teach him and then gone beyond them, but he was also an accomplished courtier and scholar. He was learned in science and politics, and spoke fluently seven languages. Added to this he had a fine presence and a natural charm of manner that gave him prestige in any court circle.

PETER PAUL RUBENS
Painter, Scholar, and Diplomat

"The city of Rubens" is the proud boast of the Flemish city Antwerp. But though a citizen of Flanders during the period that it was a possession of the Spanish king, Rubens was born in Germany during his father's exile from his native land. For eight years he was court painter to the Duke of Mantua in Italy; he was called to the court of France to adorn the palace of the Luxembourg in Paris; and he was knighted by Charles I of England and by Philip IV of Spain when in 1627 he negotiated the conclusion of peace between these two countries. But above all he was the artist who took the best from the art of the Italian Renaissance and united it to the best from the art of the north, adding his own individual coloring and boldness of design to create an art influence that was felt throughout Europe for generations after his death.

In his palatial home in Antwerp Rubens entertained scholars, nobles, and sovereigns. Pupils flocked to him in such numbers that there was always a long waiting list. In his later period commissions for paintings came so fast, and the paintings ordered were of such vast size, that Rubens himself usually did only the sketches for the composition, the principal figures, and the finishing strokes. The filling in was done by paid assistants and pupils, many of whom were themselves masters. Van Dyck, one of the world's foremost portrait painters, was one of the many who served in Rubens' Antwerp studio.

In his private life Rubens was no less fortunate than in his professional career. The whole world is well acquainted with his first wife and his charm-

A GEM OF SILK AND GOLD

THE gorgeous fabric of silk and gold thread shown on the following page was made by Persian weavers for the Shah's palace sometime during the 18th century. In it we can see how Oriental rug weaving contains the lessons and traditions of a race over hundreds of years, all worked in with infinite care, thread by thread.

Because this rug was made toward the end of the "Golden Age" of Persian rug-weaving, the style is "Ispahan," and the rug naturally is "royal" as well. The full name is "Royal Ispahan Prayer Rug." The fact that it is a prayer rug, on which the devout Mohammedan kneels while addressing his daily prayers toward Mecca, we learn from the general pattern. It "points" at one end, and this end is set toward Mecca before prayer begins.

The prayers, woven into the rug in curious Oriental script, are a feature not commonly seen. The weavers achieved a superb decorative effect with them. In the symbols and general design we see typical Persian art in its most refined and freest style, as contrasted with Armenian, Caucasian, or Turkish designs, which are commonly mere geometric patterns worked out in stronger colors. The vinelike curls and detached flowers visible in the picture, with the general suggestion of a temple overlooking a garden, are a definitely Persian conception, tending dangerously close to a violation of the Mohammedan law which forbids making images of any living thing.

The texture of the rug, which we cannot fully appreciate because we cannot look below the surface, also reveals many secrets to the expert. Its superb quality is explained by the fact that the patient weavers placed some 1,000 knots of silken fabric to the square inch, on the crisscross of warp and weft, to form the pattern. Such fine close work gives a surface smooth as the finest velvet.

The use of silk is characteristic of rugmakers in touch with India, as the Persians were, and able to afford costly silk for their work. The more usual stuffs were wool for the pile, and wool or cotton for the "foundation" warp and weft. The trick of using gold threads to enrich the pattern is sometimes called Polonaise, from a notion, once widely believed, that the Poles contributed this idea.

Courtesy of Nahigian Brothers *See text on preceding page*

A GEM OF SILK AND GOLD

ing children, because he used them over and over as models. It knows even better his young and beautiful second wife, Hélène Fourment, whom he made perhaps the most frequently painted woman in history.

Probably no other artist has covered such a vast area of canvas, and none has excelled him in variety of skill. In the approximately 1,300 paintings and 400 drawings credited to him, animals are as skilfully done as if he had spent his life studying animals. His landscapes and mythological pictures are masterpieces. His murals for palace or cathedral show expert handling and technique. His portraits and his religious paintings rank him with the supreme masters in these fields. All this varied work is marked by abounding vigor and zest for life.

Works by Rubens are to be found in most of the large art galleries of the world. The 'Descent from the Cross' is in the Antwerp Cathedral. 'Madonna Surrounded by Children' and a series illustrating the life of Marie de' Medici are in the Louvre. The Boston Art Museum has 'The Marriage of St. Catherine' and the Chicago Art Institute has 'Portrait of Spinola'. The New York Metropolitan Museum has eight, including 'Return from Egypt', 'Venus and Adonis', and 'Adoration of the Magi'. There are two in the National Gallery of Art, in Washington, D.C., 'Isabella Brant' and 'Head of One of the Three Kings'.

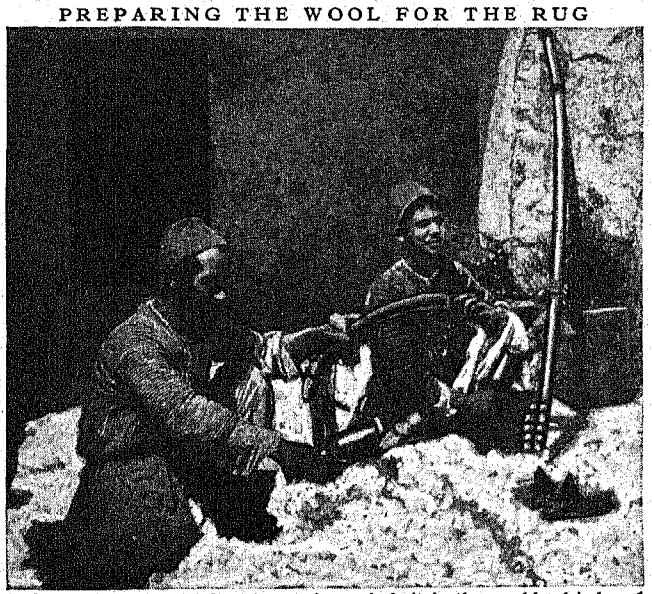
The FINE ART *of the* WEAVER'S LOOM

How Beauty Plays through Warp and Woof in the Rugs and Carpets of the Orient—The History, Art, and Geography of an Exquisite Craft

RUGS AND CARPETS. The oriental rug is almost the sole article of home decoration which we share unchanged with the centuries long past. It is prized today for its beauty, the warmth and vividness of its enduring coloring, and its remarkable wearing qualities, just as it was when it embellished the halls of kings and sultans of a bygone day. And in the mountain districts of western Asia—Persia, Anatolia, and Syria—where the art early attained perfection, rugs are today woven by descendants of the first rugmakers with implements that differ in few respects from those used by their forefathers.

The rug in the Orient is not only floor covering but also wall hanging, bedding, and furniture. Not only was it a source of comfort in the home, but it had a prominent place in religious ceremonies and as temple, mosque, and church decoration. The Mohammedan has his prayer rug which he spreads and kneels upon at the hour of prayer, with the point of the design toward Mecca, the direction in which he bows his head. Rugs are also used as saddle-bags, and trappings for camels and horses. Originally women were the only weavers. Where rugs are not made for the trade, as they are now in many districts, women still are the sole rugmakers. Each weaver has a special design handed down in her family.

PREPARING THE WOOL FOR THE RUG



Before the wool for oriental rugs is carded, it is thoroughly dried and worked up into a fluffy mass. In this process the wool is beaten, as you see. In order to keep it from matting, that large bow you see suspended there is taken down from time to time and held over the wool while its string is plucked violently. The vibrations of the string, striking the fibers of the wool, whip them up again to a fluffy pile.

Let us watch one of these rugmakers at work at her loom, which consists only of two upright poles—often they are only straight limbs of trees set up in the ground. These poles hold two horizontal bars, one fastened at the top and the other at the bottom; and to these bars the threads of the "warp," which are usually hemp or cotton, are attached.

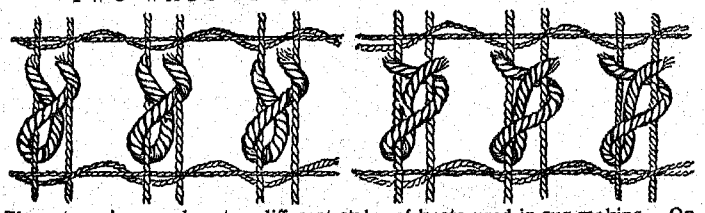
The rugmaker first weaves a firm and substantial edge, or selvage, by throwing in and out between the warp threads several rows of "weft," of the same material as the warp (*see* Spinning and Weaving). When the selvage is sufficiently wide (and in some rugs it has a design of its own), the tying of the little tufts which makes the "pile"—that thick soft velvety surface of short protruding ends—is begun. All oriental rugs have this pile, with the exception of the Kelims, which are woven flat like tapestry and are used for wall coverings, and Cashmeres, which resemble the old Cashmere shawls of India for which they are named.

The yarns used may be of wool, camel's hair, or silk or a combination of the three, with sometimes gold and silver threads intermingled. In rugs made in the old way, the yarns are carefully dyed with vegetable colors, according to secret formulas handed down in certain families for generations. Often the

dyed yarns are left in the sun and rain and wind for weeks until the dye becomes a permanent part of the fibers of the yarn itself. Colors are thus obtained which in softness, brilliance, and permanence greatly excel those produced by the aniline dyes used by some unscrupulous imitators of the ancient weaves.

The rugmaker uses in her weaving two simple implements—a coarse wooden or metal comb, and a pair of shears; and the operation of tying the yarn so as to make the rug is so simple as to be almost unbelievable when the finished product is considered. She catches up a bit of yarn, winds it about the two warp threads, ties it tightly, and brings it up through so that the short ends will protrude. These ends are then clipped to an even surface. There are two ways in which the knots are tied—the Sehna (Persian) knot, and the Ghiordes (Turkish) knot. The Sehna knot is really more of a twist, arranged so that from each space between the warp threads the end of the pile yarn comes through. The Ghiordes knot, on the contrary, is more like a real knot, both ends of the yarn coming through together between every two threads of the warp. More knots can be tied to the square inch by the Sehna method, and the pile can be trimmed down more closely, as there are no knots or spaces to conceal. The number of knots to the square inch determines the value of the finished rug, and some of the finest rugs have as many as 700 knots to the square inch.

TWO WAYS OF TYING WEAVERS' KNOTS



These two pictures show two different styles of knots used in rug making. On the left is the Sehna knot, used in many parts of Persia, and on the right is the Ghiordes or Turkish knot which is used in Turkey and generally throughout Asia Minor.

Using one or the other of these methods, the rugmaker ties tuft after tuft separately, working out the tedious intricate design with the various colored yarns. After a row has been tied the width of the loom, one or more weft threads are woven across, and pressed down tightly above the row of tied tufts with the comb, to make the work solid and fast. It is the slowness of this hand work which accounts in large measure for the costliness of oriental rugs. All classes are represented among rugmakers—men and women, boys and girls, the people of the towns and the wandering nomad tribes. In Persia, in the Caucasus district, and in many parts of Turkey, rug weaving is the main industry. But in recent years many rugs offered for sale as true orientals are of loose weave, careless design, and poor workmanship, and dyed with chemical dyes.

Oriental rugs are usually classed geographically as Persian, Turkish, Caucasian, Turkoman, Indian, and Chinese. Each of these six main divisions has many sub-divisions, named usually from the various districts of the country. The rugmakers of a district follow a single general design, which all the families copy and have been copying for centuries with slight variations of colorings or size; but usually each weaver puts a great many personal touches into the rug he or she weaves, so that oriental rugs even of the same district are rarely exactly alike. The rugs of all Mohammedan countries are characterized by their geometric or very highly conventionalized flower and animal designs, as the Mohammedan religion prohibits the representation of any form of life.

Persia, on account of the great artistic beauty of its rugs and their superior workmanship, attained fame as the real home of the oriental rug as early as the 16th century and has held it ever since. There are at least 14 varieties of Persian rugs, among which are Khorassan, Meshed, Herati, Shiraz, Kirman, Tabriz, Sehna, Serebend, Teraghan, Saruk, Herez, Hamadan, Sultanabad, and Ispahan. The Shah of Persia in his palace at Teheran has a marvelous collection of antiques, among which is the carpet that belonged to the famous peacock-throne at Delhi. Persian designs are characterized by a floral pattern.

The geometric design is carried to perfection in the Caucasian rugs, which show star shapes, circles, fretwork, diamonds, triangles, and various forms of the *Swastika* (卐) in bold design. The rugs listed as Caucasian are Daghestan, Cabistan, Chichi, Circassian, Derbend, Kazak, Guenjes, Cashmere, Shirvan, and Karabagh.

The Kurds combine the designs of Persia and Caucasia in five kinds of rugs, known as Persian Kurdistan, Turkish Kurdistan, Sumak, Mousul, and Kelim. The latter, as stated above, are without pile, and are closely woven in beautiful design and color. They are used as rugs, tent hangings, and blankets.

Among the old Turkish rugs are some wonderfully beautiful ones—the Ghiordes, Kulah, Bergamo,

THREE KINDS OF CARPET EVERYBODY HAS SEEN

Here are three familiar kinds of carpet. The one on the left is Body Brussels. Notice how clear and precise the pattern is. Next is the Wilton, known for its durability as well as its beauty—clean-cut, soft, and luxurious. The third pattern is Axminster, of the "spool" type, which has a loose, soft, and very agreeable texture and is often worked out in elaborate and florid designs.

CARDING AND SPINNING WOOL IN ARMENIA

For carding, a comblike device is used, or sometimes a board with nails driven into it. Much of the spinning is done by shepherds while tending their sheep. They take a good supply of wool with them in the morning and, with simple spindles, spin away hour after hour in the sunshine.

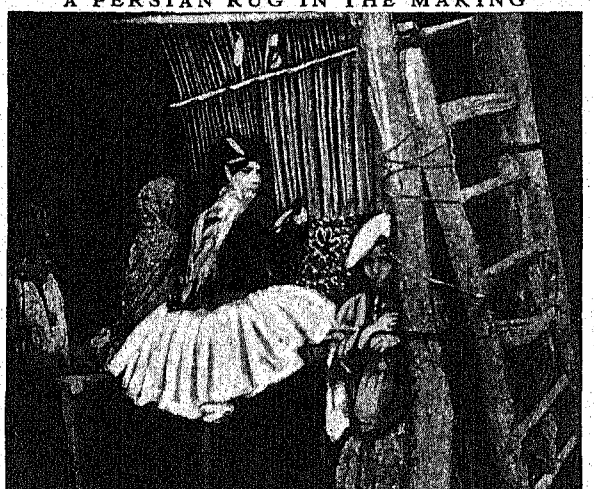
Ladik, Yuruk, Melez, Kir-Shehïr, and Turkish Kelim rugs. Turkoman rugs come from Russian Turkestan and are known as Bokhara or Tekke, Khiva or Afghan, Yomud, and Baluchistan weaves. The Bokharan rugs are marked by a beautiful straight-line pattern and their color is rich and harmonious.

Indian rugs are closely woven, heavy, and of attractive colors, and usually have a large center medallion. The manufacture of these rugs is largely in the hands of American and European firms. The large medallion center and smaller border in green, blue, crimson, and yellow are characteristic of this weave. Beautiful silk rugs come from Tanjore, Masulipatam, and Benares.

Chinese rugs are of surpassing beauty, consisting usually of highly conventionalized designs on a solid field of exquisite shades of blue, yellow, red, fawn, gold, or tan. Some of these rival, in sheen and iridescent gleam, the finest Persian rugs.

In the United States the blankets and rugs of the Navajo Indians compare rather favorably with the productions of the Far East. Colored with native pigments, they wear for years. (*See* Arizona.)

A PERSIAN RUG IN THE MAKING



Do you wonder that Oriental rugs are so expensive, when every thread has to be woven in place by hand? This expert weaver is a Kurdish girl in Persia, wearing the high boots and voluminous short skirts of the national costume.

During the Middle Ages hand-knotted pile rugs were made in Europe in imitation of the imported oriental ones, but owing to the length of time required to make them they could be afforded only by the very rich. The most common floor coverings were ingrains and coarse tapestries, woven on hand looms, and even these were considered luxuries.

Today woven carpets have a considerable use as floor coverings. "Ingrain" carpeting gets its name from the fact that the yarn or "grain" is dyed before weaving. It is made with two colors of yarn, the design appearing in reverse colors on different sides of the fabric. This carpet is now made by machinery and is known as Kidderminster, from the town where it was first made in England, or Scotch, from the place of its origin.

Designs on tapestry carpets were originally made by using many bobbins, each containing a different color (*see* Tapestry). In 1832, however, a method was invented which allowed the patterns to be dyed or printed on a single warp thread before weaving, great care being taken so that the colors came up in exactly the right places in the design.

Hand-woven tapestries and ingrains, however, were flat, having no pile. In the middle of the 18th century a heavy carpet was invented in imitation of floor tapestry, with a thick looped pile made by passing the warp threads over a stout wire which was later withdrawn. Although invented in England this was called Brussels carpet, from the city where tapestry was woven. The figures were formed by warps of different colors that were buried in the body when not wanted on the surface. In carpets of this kind you can usually tell the number of the thicknesses of worsted in the fabric by counting the colors.

Later Wilton carpets were made, in exactly the same manner as Brussels, except that the loops were made over a larger wire, and were cut as the wire was withdrawn. Thus Wilton carpets have a velvet instead of a looped pile. This looped pile method was also applied to the making of tapestry carpets, which, when the loops are cut, is known as velvet carpet. Thus velvet is to tapestry what Wilton is to Brussels.

Early in the 19th century a great improvement in producing carpets occurred when the Jacquard apparatus, used in weaving to regulate patterns, was applied to the hand manufacture of carpets. It was not until later, however, that floor coverings came into general use. In 1841 Erastus B. Bigelow, a medical student in Boston, harnessed an ingrain loom to steam power and so increased the output from 8 yards a day to 25 yards. He also patented a power loom for weaving Brussels and Wilton carpets, and another for weaving tapestry carpets. Since then, innumerable improvements have been made in carpet manufacture.

Of machine-made carpets, Chenille Axminsters are the richest and costliest. They belong to the tufted or velvet pile class, the most expensive having piles seven-eighths of an inch high. Most of them are made in plain effects, often with two or three tones; but ingenious machinery has been invented to insert differently colored chenille braid so as to produce the most elaborate designs. Florid and obtrusively colored designs are characteristic of a cheaper variety of Axminster, known as "spool" Axminster.

Rag carpets have been used in America since Colonial days, when every village had its weavers who made up into floor coverings the balls of rag strips sewed together by economical housewives.

Grass rugs, made of tough fibers, have become popular in recent years for special uses. Some have their colors woven into the mesh and some have the decorations stenciled on the finished material.

The United States today makes and uses more carpets than any other country in the world, the manufacturing centering in Pennsylvania, New York, and Massachusetts. In Philadelphia, where the first carpet factory was established in 1791, more carpets of all grades are made than in any other city in the world. They are sent to all parts of the earth.

A YOUNG NATION *and an* ANCIENT PEOPLE

RUMANIA (*rụ-mā′nĭ-ȧ*). No nation in the turbulent Balkan Peninsula has had a stormier history than Rumania. Its factional quarrels, its racial minorities, and its territorial disputes with neighboring countries have combined to create many crises during its history as an independent nation.

This region just north of the lower Danube was the Roman province of Dacia under the emperor Trajan, and its present inhabitants claim descent from Roman colonists of that time, and regard their land as "an outpost of Latin culture set in the East." In appearance and language the Rumanians are like the Italians, though with much Slavic admixture. At the end of about 400 years of Turkish rule, during which there were costly struggles also with Poland, Hungary, and Russia, the Treaty of Paris (1856) recognized the two provinces, Moldavia and Walachia, which lay between the Carpathian Mountains and the Black Sea, as "autonomous" (self-governing) parts of the Turkish Empire. Their coalition in 1861 formed the new nation Rumania (or Roumania, native "Romania"), to which a German (Hohenzollern) king was given in 1866. In 1878 complete independence was achieved. In the second Balkan War (1913) Rumania aided Serbia, Greece, and Montenegro against Bulgaria, and was rewarded by a slight extension southward of the district on the Black Sea known as the Dobruja.

Sheepskin coats and heavy wrappings for the legs are necessary in the bitter winters of Rumania. This peasant is equipped to defy the winds to do their worst.

In the World War of 1914–18 Rumania disappointed German hopes by siding with the Entente Allies. As a result it was terribly ravaged by a German-Austrian-Bulgarian army in 1916 and forced to sign a humiliating peace. But when the Central Powers were finally defeated, Rumania won her reward, receiving under the peace treaties the former Hungarian territory of Transylvania (west of the Carpathians), the former Austrian district of Bukovina (on the north), and Bessarabia (across the River Pruth to the east), which had been a part of czarist Russia. (For map, *see* Balkan Peninsula.)

Rumania was thus more than doubled in size and population. But its neigh-

bors were never reconciled to their losses. Rumania was enabled to keep its new territories largely because of the support of Great Britain and France. In 1940, when war in Europe had rendered those countries powerless to aid their ally, Rumania's neighbors seized the opportunity to regain almost all the territories they had lost. Soviet Russia took Bessarabia and northern Bukovina; Hungary was awarded northern Transylvania; and Bulgaria was ceded southern Dobruja. Rumania was left with an area of approximately 72,600 square miles and a population of about 13,400,000.

The Riches of the Land

The eastern part of the country, a region of plateaus and plains, is really a westward extension of the "black earth" region of Russia. Its rich loess soil makes it one of the great cereal-growing regions of Europe. Corn and wheat are the leading grains produced; barley, oats, potatoes, sugar beets, and tobacco are also important crops. Cattle and sheep graze on the foothills and plains; in summer they are driven in great numbers to mountain pastures. The slopes of the foothills grow fine fruits, especially grapes; and Rumania is noted for its fine red and white wines and for its plum brandy.

The forests which clothe the slopes of the towering Transylvanian Alps (part of the Carpathian system) furnish abundant timber, and the vast mineral resources include rock salt, coal, marble, petroleum, gas, lignite, iron, manganese, copper, gold, and silver. The Rumanian oil fields are among the most important in Europe, and are one of the chief resources of the kingdom. The state controls the mines and forests. Carp, sturgeon, salmon, and pike are caught in the well-stocked Danube. Food products, electrical machinery, chemicals, textiles, and refined ores are among other important sources of wealth.

In winter the bitter Russian winds send the thermometer below zero, and for three months the broad spacious Danube, Rumania's chief artery of commerce, lies ice-locked, and the ports of Galatz and Braila are quiet. The summers, on the other hand, are tropically hot. Spring with its blooming fruit trees and fall with its harvests are all too short. The state owns the chief railroads and is extending their mileage, for much of the countryside is handicapped by poor transportation. At Cernavoda a great bridge 12½ miles long crosses the Danube and its wide marshes, carrying trains from the capital, Bucharest (Bucuresti), across Dobruja, "the stony region," which separates Rumania proper from its chief Black Sea port, Constanta (Kustenje). Most of the manufactured articles which Rumania uses come from foreign countries. Its chief exports are grains, lumber, and petroleum.

PROSPERITY IN MODERN RUMANIA

Smart shops and cafés line the Calea Victoriei, the main street of Bucharest, the Rumanian capital, known as the "Little Paris" of the Near East. The lower picture shows a great oil field near Campina. Oil is an important source of wealth in Rumania, and is under government control.

West of the Transylvanian Alps lies the rich and picturesque upland region of high mountains and valleys called Transylvania. Here fruit raising is extensive; rye, wheat, oats, corn, and potatoes are the chief crops; and there are vast pastures for sheep, cattle, and horses. Forests of pines, beeches, and oaks clothe the mountains. Transylvania also is rich in minerals. The northern and eastern half of this region was returned to Hungary in 1940. Thickly forested little Bukovina, the southern portion of which belongs to Rumania, has many old churches and monasteries, with paintings all over their outside walls.

The People and the Cities

The vast majority of the people are farmers. Most of the peasants own their own small farms, but they employ almost primitive methods of farming. Reaping is still often done with sickle and scythe. The Greek Orthodox church, to which most of the people belong, is the established church. Wayside crosses mark the simple faith of the countryside. Most of the peasants, who are generally illiterate, speak Rumanian; the educated habitually speak French. Racial and religious

minorities speaking foreign languages make up a large part of the population, and are the chief reason for the continual crises in Rumania's national life. These include Germans, Magyars, Ruthenians, Jews, Poles, Serbs, and Czechs.

Bucharest, the capital and largest city of Rumania, is a gay, modern, and thoroughly Latin metropolis (*see* Bucharest). It long has dominated the trade routes from Russia to the northern Balkan states. Jassy (Iasi), former capital of Moldavia, plays a significant rôle in politics. The ports of Galatz, Braila, and Constanta also are important cities.

Peasant Life

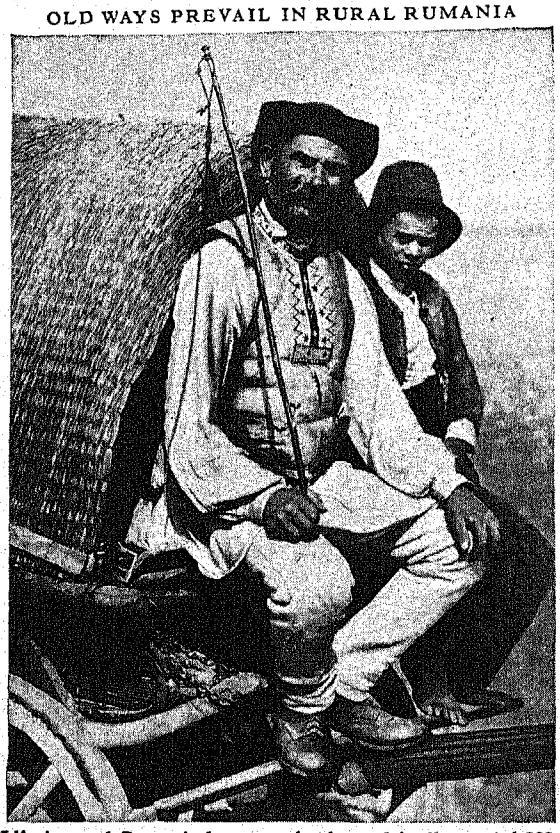
The simple peasants forget the hard toil of the week as they dance on Sundays, the men in brightly stitched sheepskin jackets, the women wearing kerchiefs, gay aprons, and full blouses richly embroidered in vivid harmonious colors by their own hands. The thatched whitewashed cottages are warmly built, usually with porches running around them. Nearly everything is made at home, from the men's goatskin sandals and the hand-woven linens to the tall stoves. The daily diet, highly seasoned with red peppers, consists chiefly of corn, porridge, and vegetables, with a bit of pork and chicken. Though Rumanians are themselves skilful with violin, guitar, and flute, they always call upon the gipsies to play at their festivals.

When the peasants get together on winter nights, they sing and tell of wars and heroes, of spirits and legends—these are the wild, sad folk-tales of the Balkans. Rumania's literature shows the outside influence of Slavs, Greeks, French, and Italians. George Coşbuc, the peasant's poet; Michael Eminescu, melancholy mystic poet; Ioan Carageale, satirical dramatist; and Dobrogeanu Gherea, critic, are notable. Under the name "Carmen Sylva," Queen Elizabeth, wife of Charles I, who ruled from 1881 to 1914, wrote and edited many works, with Mite Kremnitz, her lady-in-waiting.

A Nation Torn by Strife

Queen Marie was the real ruler during much of the reign of her husband, King Ferdinand I, 1914–1927. Her son, Prince Carol, abdicated in 1925 in favor of his own young son Michael (Mihai); but he returned to Rumania in 1930 and was crowned as Carol II. As Europe headed toward war, Rumania in 1939 received guarantees of its independence from England and France. With the defeat of France by German arms, Rumania, in an effort to save itself from partition, adopted a semi-fascist form of government modeled after Germany's. But this did not avert the loss of Rumanian territory, in 1940, to Russia, Hungary, and Bulgaria.

OLD WAYS PREVAIL IN RURAL RUMANIA



Life in rural Rumania has scarcely changed in the past 1,000 years. The farmer raises nearly everything he needs, his wife spins and weaves his picturesque shirt and embroiders his jacket. These hardy peasants descended from the Romans.

On September 5 Gen. Ion Antonescu, backed by the fascist Iron Guard, became dictator. The next day King Carol was compelled to abdicate and flee. His 18-year-old son ascended the throne a second time, as Michael V. In October German troops were permitted to occupy the country. Then, in June 1941, when Germany invaded Russia, the Nazi-controlled government of Rumania declared war, regaining in a few weeks the land it had lost to the Soviet Union. (*See also* World War, Second.)

RUMINANTS. Nearly all the mammals most useful to man—cows, sheep, goats, camels, llamas, deer, and antelopes—have the habit of swallowing their food and later bringing it back to the mouth to be chewed thoroughly at leisure. Hence they are called the "cud-chewing" animals, or ruminants. Their ancestors, being an easy prey to the stronger, fiercer, flesh-eating beasts, many thousands of years ago took to protecting themselves by swallowing their food hastily in the open places and retiring to more concealed positions to chew at their leisure.

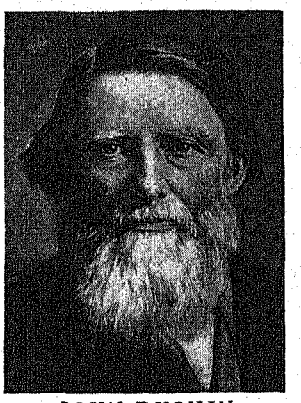
This is made possible by their complicated stomach with four compartments—the paunch or *rumen*, the *reticulum* or honeycomb bag, the *omasum* or manyplies, and the true stomach or *abomasum*. The food when first swallowed goes, in the form of a coarse pellet, into the paunch, the largest of the four compartments. There it is softened and passed into the reticulum, where it is molded into pellets or "cuds" of convenient size. Later, these are passed up into the mouth by *regurgitation*, a process the opposite of swallowing. After mastication they are swallowed again, passing into the third stomach or manyplies, then into

the fourth compartment or true stomach. The camels differ from other ruminants in having no third stomach.

Cows, sheep, goats, and all the other ruminants except camels and llamas have no front teeth in the upper jaw. Instead the gums form a tough pad. In grazing, this pad holds the grass across the sharp edges of the lower front teeth. Then, with a sideways jerk of its head, the animal shears through the grass stems. The back teeth of ruminants are specially adapted for the kind of rotary grinding needed to shred and break up vegetable fibers.

RUSHES. The whole assemblage of grasslike plants covering bogs and marshes is popularly spoken of as rushes or sedges. The true rushes, however, belong to a distinct family (*Juncaceae*), comprising more than 800 known species. They are closely related to the lilies, and all have tiny, greenish, lily-like flowers. The leafless and unbranched stems are usually hollow or filled with soft pith. The leaves are long, slender, and grasslike. Rushes are used now for basket-weaving, chair bottoms, ropes, etc.; but in medieval times in Europe they were strewn on floors and used as bedding. The pith of certain species was used for wicks in making "rush lights." Some species of both sedges and rushes are called bulrushes. The American bulrush is a sedge (*see* Sedge). "Horsetail" rushes, or *Equisetum*, are not rushes, but are close relatives of the ferns. They contain much silica, or sand, and are used for scouring, and so are called "scouring rushes." It is believed that in early geological times these "horsetails" grew to giant trees.

RUSKIN, JOHN (1819–1900). Do you know the charming fairy tale of 'The King of the Golden River', who helped the kind-hearted Gluck and turned the wicked brothers into black stones? John Ruskin, who wrote this story, was not unlike the kind Gluck himself. When his father left him a fortune of a million dollars he gave almost all of it away to art museums and charities. The story ends, "And Gluck went and dwelt in the valley, and the poor were never driven from his door; so that his barns became full of corn, and his house of treasure." Though Ruskin never got back his treasure, as Gluck did, he certainly never was in want, for his writings brought him in $20,000 a year.



JOHN RUSKIN
The Great English Art Critic

From the time Ruskin was a small boy until he was about 40 years old his writings, which were many, were all about art, mostly about painting and architecture. His 'Modern Painters', 'The Seven Lamps of Architecture', and 'The Stones of Venice' gave the people of Queen Victoria's reign a new interest in art and a new point of view toward it.

But when he was about 40 he began to be more interested in humanity than in art and he became a social reformer. His writings changed and began to describe what he thought would be an ideal state of society and how he thought this could be brought about. But, while Ruskin really knew a great deal about art, he knew comparatively little about sociology or economics. So he was really more successful in his early writings than in his later ones, though 'Sesame and Lilies', a popular statement of some of the simpler of his sociological ideas, is also very well known.

Almost as important as the things Ruskin said is the *way* he said them. He wrote beautiful clear English, at times very simple and straightforward, and at times rather highly decorated and colored; but always beautiful, so that he has helped many a young writer to learn how to use the language.

Ruskin was born and lived in England, but his parents were Scottish. His father was a wealthy wine merchant, and as John was their only son the parents devoted themselves almost entirely to his education, traveling with him through Europe. Some of the best artists in England taught him drawing and painting. Later he went to Oxford, where he took a prize for poetry, and was graduated in 1842. In his later life he was professor of art at Oxford until his health failed and he retired.

His autobiography, 'Praeterita', tells of his early life. His works amount to more than 50 volumes. Aside from those already mentioned the best known is probably 'The Crown of Wild Olive'.

RUSSELL, JOHN (1792–1878). In a great mass of journals and memoirs, the English statesman and Whig leader Lord John Russell recorded his long and eventful life. He tells of his boyhood in London, where he was born, of his school days at the University of Edinburgh, of his travels on the Continent, and of his entry into Parliament at the age of 21.

The most exciting part of the story occurred in 1832—the year of the great Reform Bill. The Tory Duke of Wellington had been forced to resign as prime minister, because he was opposed to the reform of Parliament. The Whigs (Liberals) then came into power with Earl Grey as prime minister. Lord John Russell was given the task of championing the measure which did away with the "rotten boroughs" (where few or no people lived) and gave representatives to the new manufacturing cities, which had not been represented in Parliament. The bill also increased very modestly the number of people who might vote. The House of Lords rejected it. Elections were held, and excited mobs demanded "the bill, the whole bill, and nothing but the bill." Finally the Lords were forced to yield because of the threat that enough Whig peers would be created to give the necessary majority in their house.

The rest of the story was less eventful. His share in the great political and humanitarian reforms that followed was unimportant. No great laws were passed in Russell's first term as prime minister (1846–52), and his second term (November 1865–June 1866) was too short to allow him to accomplish anything.

By this time he had lost much of his popularity in the country. His sympathy with the South during the American Civil War led the friends of America to believe that he had purposely allowed the Confederate cruiser *Alabama* to escape in 1862 (*see* 'Alabama' Claims). The mismanagement which marked England's entrance into the Crimean War (1854–56) was blamed on him, and his policy as secretary of state for foreign affairs did not meet with the approval of the country.

Russell—Earl Russell since 1861—was as prosaic a writer as he was a speaker. As one of his fellow-workers once said "it is seldom that languid Johnny turns to glorious John." When he retired from public life in 1866, at the age of 74, Gladstone took his place as leader of the Liberal party.

The SOVIET UNION, *Hugest of* NATIONS

RUSSIA (UNION OF SOVIET SOCIALIST REPUBLICS). Across the top of Asia and eastern Europe stretches the vast nation of the new Russia—the Union of Soviet Socialist Republics. No other single nation in the world is as large; and no empire is larger, except the British Commonwealth of Nations with its overseas dependencies. Even before its gains by conquest and treaty in 1939–40, the Soviet Union occupied more than one-seventh of the land surface of the earth. It was greater in extent than Canada and the United States, including Alaska, combined. Its greatest east-west length was more than twice the distance from New York to San Francisco. (For maps, *see* Asia; Europe.)

Extent.—East to west, greatest distance, about 6,500 miles; north to south, about 2,400 miles. Area (excluding gains by conquest and treaty in 1939–40), about 8,200,000 square miles. Population, about 170,470,000. Composed in 1939 of the following Soviet Socialist Republics: Russian, Ukrainian, Byelorussian (White Russian), Azerbaijan, Georgian, Armenian, Turkmen, Uzbek, Tajik, Kazakh, and Kirghiz.

Natural Features.—Caucasus, Ural, and Yaila mountains; Pamir Plateau. Rivers: Volga, Dnieper, Don, Dvina, Ural, Dniester, Pechora, Ob, Yenisei, and Lena. Lakes: Ladoga, Onega, Ilmen, Balkhash, Baikal, Aral, and Caspian Sea.

Products.—Wheat, oats, rye, barley, millet, corn, buckwheat, potatoes, sugar beets, sunflowers, cotton, flax; timber; horses, cattle, sheep, goats, swine; coal, peat, petroleum, iron, manganese, chromite, gold, platinum, asbestos; sugar, flour; textiles; lumber, wood pulp and paper; fish and caviar; meats, butter, furs, hides; steel, machinery, petroleum products, fertilizers, cement, glass, matches.

Cities.—Moscow (capital, 4,135,000); Leningrad (3,195,000); Kief, Kharkof, Baku, Gorky, Odessa, Tashkent, Tiflis, Rostof-on-Don, and Dnepropetrovsk (all between 850,000 and 500,000).

The old Russian Empire of the czars was even more extensive. It included Finland, Esthonia, Latvia, Lithuania, and parts of Poland and Rumania, which were stripped from the Soviet Union after the 1917 revolution. There were roughly four main divisions—Russia in Europe, the Caucasus, Siberia, and Russian Central Asia. The keystone of the whole huge structure, the center from which Russian authority radiated, was Russia in Europe, called "Great Russia" or "Muscovy." The latter term, derived from Moscow, its ancient and now its modern capital, was commonly used until the 18th century. The general name "Russia" is still given to this huge land, sometimes referring to European Russia only, sometimes to the whole Union, both Asiatic and European. The official title, "Union of Soviet Socialist Republics," is usually shortened to "Soviet Union."

Birth of the Soviet Union

The Russian Empire fell to pieces in the chaos of the 1917 revolution. Finland, Esthonia, Latvia, Lithuania, Poland, the Ukraine, Georgia, Azerbaijan, parts of Siberia, and other regions set up independent governments. For a while, the name "Russia" meant only the region of which Moscow was the nucleus

IN THE BLEAK SNOW-BOUND NORTH

These dwellers on the "tundras" of northern Russia are fishers and hunters, whose wealth is chiefly in their reindeer herds. In the distance are the stunted Arctic forests.

—a territory about one-fourth the size of the old empire. Russia acknowledged the independence of Finland, the Baltic countries, and Poland, but later won back most of the territory it had lost.

A treaty setting up the present Soviet Union was signed at Moscow in 1922 by the following republics: Soviet Russia (R.S.F.S.R.), White Russia, Ukraine, and the Transcaucasian Federation (since 1936, the Georgian, Armenian, and Azerbaijan Soviet Socialist Republics). The Uzbek and Turkmen republics were formed in 1924; Tajik Republic in 1929; Kazakh and Kirghiz republics, formerly part of the R.S.F.S.R., in 1936. Still other republics were added later.

Geographical Factors

Except for its mountain fringes, European Russia is almost uniformly flat, in contrast with the varied surface formations of western European countries. Its vast central plains lie far from the Atlantic Ocean and from the great international trade routes. The development of manufactures and the exploitation of its resources, therefore, have been more difficult for Russia than for countries bordering on the Atlantic and the Mediterranean with direct access to the principal ocean highways. Of the four land-locked seas on which it has a foothold, the Caspian has no outlet, the exits of the Black and the Baltic are commanded by other countries; while Archangel, the port of the White Sea (an arm of the Arctic Ocean), is icebound for six months of the year. The Murman coast of the Arctic, although 300 miles farther north, is warmed by the last of the Gulf Stream and its port of Murmansk is ice-free the year round. Hence Murmansk played a vital rôle in both World Wars, for much of Russia's military supplies were brought in through this port.

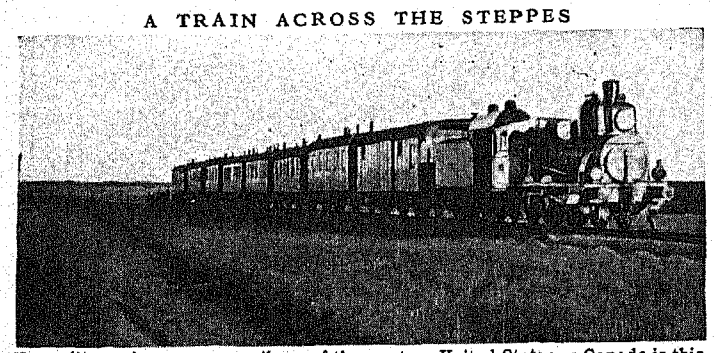
RUSSIANS OF THE FAR SOUTH

This smiling round-faced peasant woman of the Ukraine, her bare feet half buried in straw, is preparing fodder with a rude chopping machine.

Russia's great rivers to some extent compensated for its failure to reach open seas. During its early history, the Dnieper linked Russia with Byzantium (Constantinople), the Volga with the Caspian and Asia, and the Neva and the Volkhof with western Europe. The main water parting is the Valdai Hills, a low plateau about 200 miles south of Leningrad, where rise the great highway streams of the Don, the Dnieper, and the Volga. Canals connecting rivers and lakes make it possible to pass by water from the Black Sea or the Caspian Sea to the Baltic, from the Baltic to the White Sea, and from the Caspian all the way to the

Arctic Ocean. In midsummer, however, the volume of water in many of these rivers is insufficient for navigation, and in winter their frozen surfaces are highways only for sledges. Yet the cheap transportation furnished by the 50,000 miles of navigable rivers and canals is important for internal commerce, because of the underdevelopment of railroads, and the canal system has been extended in recent years.

A TRAIN ACROSS THE STEPPES



Not unlike a view on some railway of the western United States or Canada is this picture of a train crossing the steppes. But that queer little engine, if nothing else, would tell you this is no American railroad.

Like the North American Great Plains, Russia has a continental climate, with wide extremes of temperature—long cold winters, hot summers, scanty rainfall, and dry winds sweeping unchecked over the vast expanses of plains. Most places in the interior, therefore, have a much harsher climate than places on the same parallels of latitude in western Europe. At Moscow, where the mean January temperature is 14° F. and the July mean 66.5° F., the mercury may rise to 100° in July. There is, of course, considerable diversity of climate in a country which extends from the Arctic zone into the latitude of southern Italy. Olives and figs grow in the far south; only reindeer moss, lichens, and stunted shrubs on the frozen tundras or treeless wastes of the Arctic coast.

There are, from north to south, three great belts of natural vegetation: first, the marshy tundras which border on the Arctic Ocean; then great forests of conifers, birches, and other northern trees; and farther to the south the vast rolling grassy steppes, fertile and luxuriant on good soils, and barren on the bitter alkaline soils near the Black and Caspian seacoasts. No other natural feature is so distinctively and impressively Russian as the steppes. To natives of the "tight little countries" of western Europe they are often melancholy and oppressive in their immensity, but American plainsmen can understand the enthusiasm with which Russians regard their beauty, more subtle and changeful than that of the sea. The great herds of cattle and horses and flocks of sheep which graze over these fertile steppes provide Russia with an important source of wealth. Animal and poultry products, including butter, meats, eggs, hides, and wool, are among the chief exports.

The most productive region of agricultural Russia is the "black earth belt," which stretches all the way from the Carpathians to the Urals. This rich black earth is almost inexhaustible; grain has been raised on it for 50 consecutive years and more without fertilizer. Wheat from this black earth region is one of the principal commercial assets of the Soviet Union. Other important crops are rye, oats, barley, millet, corn, potatoes, sunflower, flax, hemp, and sugar beets. Cotton and tobacco are also raised.

No country surpasses Russia in natural resources, but these were exploited in only the most primitive way until the Soviet government undertook their systematic development. Old industries were expanded under the Soviet program and new ones undertaken. Among new products were farm implements, automobiles, electric generators, chemical apparatus, and Diesel motors. Some of the enormous water-power resources were developed. The huge forest areas were worked to provide greater exports of wood pulp and timber. Furs and fish were shipped in increasing quantities. Russian rivers and seas abound with the most palatable varieties of fish. Caviar (salted and prepared sturgeons' eggs) comes chiefly from the Volga and the Caspian. The Urals are one of the chief sources of platinum and asbestos. There are also within the Union rich deposits of gold, silver, copper, lead, pyrites, graphite, phosphate, chromic ores, sulphur, salt, asphalt, mica, zinc, and potassium salts. Greatest of all are the enormous reserves of coal, iron, petroleum, and peat.

A RUSSIAN PEASANT CART

Aside from the costumes of the country people, nothing is more characteristic of Russia than the many peculiar types of carriages, carts, and sleighs.

The fact that the great coal and petroleum producing centers are in South Russia made retention of these regions, or at least the maintenance of such relations as would ensure against hostile trade barriers, vital to the Russian state. The Donetz basin in

THE THATCHED HUT OF A UKRAINIAN PEASANT FAMILY

The traditional type of home for the Russian peasant is this hut of thatch and half-plastered logs. It has probably sheltered the same family and its live stock for many generations. From this ancestral home with its sagging roof and leaning walls the family goes forth to operate the new tractors and harvesting machinery on the collective farms established by the Soviet government.

southern Russia and the Caucasus region are the world's chief source of high-grade manganese.

The Russian people have always lived mostly in small, scattered rural communities and drawn a scanty subsistence from the soil. The city population was small in proportion to the vast numbers of peasants, and it was further reduced during the revolution. Under the Soviet régime, however, there has been a large movement to the cities and towns. In rural communities, the peasants have been drawn into huge collective farms, ending their isolation and some of their hardships.

For several centuries a system of communal ownership of land prevailed, centering in the *mir* or Russian village community, which periodically redistributed the plowlands among the family groups. This led some romantic-minded Russians to contrast the "holy communism" of the Russian *muzhik* (peasant) with the "pagan individualism" of western Europe. In reality the *mir* was similar in its small intermixed landholdings to the "open field" system of the medieval manor, and was a mark of economic backwardness. A moderate Russian writer on economic subjects said of the life of the peasants: "It is not life; it is the slow death of creatures incessantly hungry." Potatoes were their customary food. Sometimes they added to this a thin rye soup or a little cabbage. Meat was eaten only in the greater festivals. Their straggling villages consisted of brown wooden houses like cowsheds, ill-lighted, unventilated, rarely swept, often without beds or bed linen. Tea, which was usually only "boiled water slightly colored," was drunk in enormous quantities. The death rate, especially among children, was very high. Though women worked in the fields with the men, they were held in such low esteem that an old Russian proverb read: "A woman's hair is long, but her mind is short."

THE "MUZHIK" AT WORK

Much of Russian peasant character—patient, kindly, slow-witted, and simple—is expressed in the faces of these men in their baggy peasant costumes.

This constant hardship gave the peasants a patient, hopeless outlook on life. Such stolid fatalism was a grave handicap, for it kept them from making any great effort to improve their lot. Few left their native villages to search for a better living.

Industrially, too, Russia was incredibly backward. The Industrial Revolution, which flourished in other European countries as early as the late 18th century, did not begin in Russia until about 1900. Then Russia built enormous factories to produce textiles, iron and steel, railway equipment, other metal products, and beet sugar. But the manufactures were neither numerous enough nor varied enough to supply the needs of the huge empire. Peasants were still dependent upon their own handicraft for practically all their needs. Russia's foreign trade, moreover, still consisted chiefly of exchanging raw materials for manufactured products.

Because of the lack of transportation facilities, much of Russia's internal commerce was carried on through the medium of fairs. Many provincial cities held them annually. The greatest was the summer fair at Nijni-Novgorod (now Gorky), on the Volga, 265 miles east of Moscow. About $100,000,000 of business was transacted there annually. The fairs declined during the first World War, but were reopened in 1923. They were finally closed in 1930.

The Great Problem of "Land Hunger"

Despite Russia's backwardness in agriculture and industry under the czars, population increased. This caused a serious land problem, as increased population cut the size of peasant landholdings. In 1860 the average size had been 13 acres; by 1900 it had decreased to about 8 acres. "Land hunger" roused the peasants from their lethargy, and in the latter part of the 19th century there were many peasant uprisings. Unrest increased as the peasants became more prosperous through the labor of their children in the newly established factories. Although the revolutionary movements of 1905 and 1917 originated largely in cities, peasant land distribution was a vital problem of revolutionary leaders. When the Bolshevists gained power in 1917, they instructed the peasants to seize the land of their former landlords. The Bolshevists, however, compelled the peasants to sell produce to the Bolshevist organization at fixed prices. The peasants, therefore, reduced production to the level of their own needs. Thus, the redistribution of land gave some relief to the peasants, but added to the general poverty of the nation.

Religion Before and After the Revolution

The state religion of "Holy Russia" under the czars was Orthodox Greek Catholicism; but also within the empire were primitive fetish-worshiping pagans, Mohammedans, Buddhists, Jews, Roman Catholics, Protestants, members of other Christian churches, and a number of Russian Christian sects, such as the Malokane and Dukhobors. The Russian peasant, though deeply religious, was tolerant. The persecution of "heretics" under the czars was a state policy, though economic factors entered into the persecution of the Jews.

After the Revolution of 1917 the Russian church was disestablished, and the clergy of all sects were excluded from educational work, from suffrage, and from any recognition in the Soviet system. The Bolsheviki, realizing that religion influenced many persons to oppose the materialistic Bolshevist doctrines, pushed an anti-religious campaign, especially among the young. In 1929 the Bolshevists prohibited the teaching of any belief except atheism. The constitution of December 1936, however, recognized the right of all citizens to enjoy freedom of religious belief and practise, as well as freedom to promote anti-religious propaganda. The constitution also restored the right of suffrage to clergymen.

Factors that Handicapped Russia

Although the Russians are the most numerous of European white peoples, they were long the most backward. A number of factors contributed to keep the country from rapid development. Chief of these were the vast extent of the land and the number of different peoples speaking different languages.

The government, too, was a handicap. For centuries, it was the most extreme type of aristocratic autocracy. Under the old system of landholding, the peasants, who formed the bulk of the people, were little better than serfs. Education was meager—three-fourths of the people could not read.

Natural resources and trade were little developed. Progress in trade was handicapped by inadequate means of transportation. Seaports were few, and roads were so poor that many were impassable in spring and autumn rains. Of necessity, the rivers were the main transport highways. Despite vast railway projects in the later years of the czars, such as the Trans-Siberian Railway (6,287 miles), railroad facilities in general were beggarly. Inadequate transportation not only retarded trade development but also hampered military activities in the first World War and contributed to the economic breakdown that preceded the Revolution of 1917. Even today Russia has only about 50,000 miles of railway—about one-fifth as much as the United States.

Physical handicaps, too, hindered Russia's progress. Severe extremes of climate, frequent droughts, and uncontrolled floods were obstacles to development. The country's isolation was another barrier. Not only was Russia cut off from easy communication with the Western world and its influence, but the majority of its people were scattered through the vast land in small, widely separated villages. Each community was therefore interested in its own affairs rather than in Russia as a whole.

In all, there were many handicaps to be overcome before Russia could be a united, progressive nation.

A Sketch of Russia's History

The predominant racial strain in Russia is Slavic. A branch of the Slavs, centuries ago, settled the western fringe of the East European plain. They moved

GATHERING WHEAT IN THE GOOD HARVEST DAYS

She has just cut a swath in the flowery wheat field—this peasant woman of Central Russia—and, returning the sickle to her belt, she is preparing to bind up the sheaves. Many of these women who work barefooted in the fields are magnificent types of vigorous feminine beauty.

eastward, occupying and developing this vast stretch of inhospitable country, and passing over the contiguous continent of Asia, finally reached the Pacific. This task of empire building took many centuries and was all-absorbing. In the process of accomplishing it the stronger tyrannized over the weaker, the clever over the ignorant; and the result was the practical enslavement of the great mass of the people, and the institution of a purely autocratic government.

First Gropings for Power

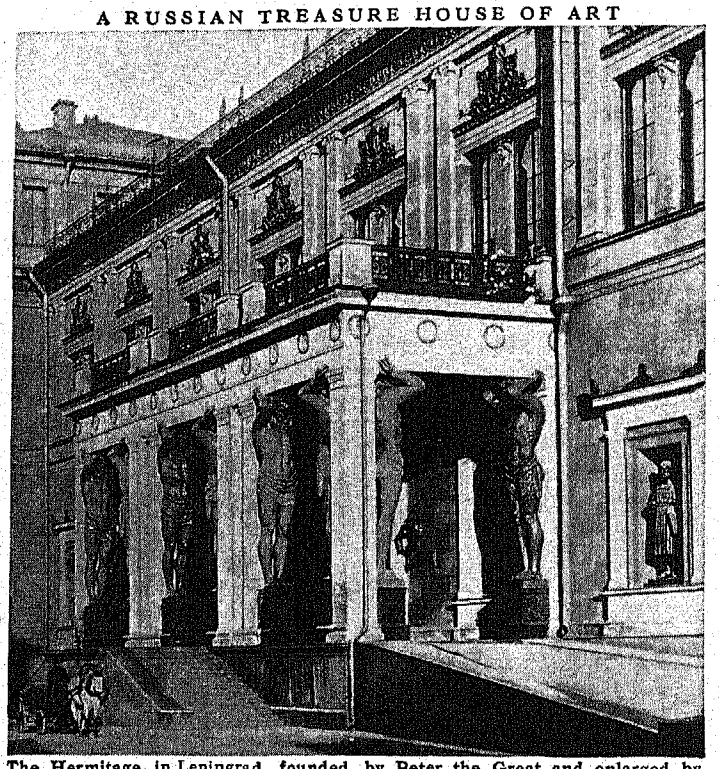
The gaining of new territory was the chief aim of the first rulers, and little thought was given to the improvement of conditions of life within the borders of the empire. This vast plain must have its seaboards, and they must be wrested from other countries. Western neighbors, fearing the young giant country which was growing up on their borders, constantly harassed it, and when it defended itself complained that it was trying to ruin all its neighbors. But still Russia grew and strengthened itself economically and politically.

We know little about these early Russian settlers before the 9th century. By that time they were settled in separate principalities on the Dnieper and the Volkhof rivers, which together formed one of the most important trade routes of the world of that day. These separate groups accepted the leadership of the Grand Prince of Kief, which was a beautiful and progressive city comparing favorably with the cities of western Europe of that period. The Russians had adopted Greek Christianity from the Eastern Church of Byzantium (Constantinople), and culture was beginning to develop in this primitive community. But in the 13th century the Russian principalities were overrun by Mongolian hordes of Tatars who came in from the East. The Russians were subjugated and forced to pay tribute to the Khan of the "Golden Horde" of Tatars. For almost 300 years the Tatar yoke rested upon the Russian people, and then, under the leadership of the Prince of Moscow, they liberated themselves. This new leader became the "Grand Prince" of Muscovy. He welded together the scattered Russian lands, proclaimed himself the Czar of all the Russias, and set about establishing and developing his empire.

At the beginning of the 17th century Russia passed through what is called her "Time of Troubles." Economic distress caused by constant wars had led to the breaking down of all authority, and anarchy prevailed. Her jealous neighbors on the west, Poland and Sweden, tried to take advantage of this situation and to finish off the sick and troubled country. Again a national awakening came, with the accession of Michael Romanof (1613-1645), founder of the Romanof line, and the "foreigners" were driven out of public affairs.

About the beginning of the 18th century Peter the Great came to the throne (1689–1725), and with him the modern period of Russian history may be said to begin (*see* Peter the Great). He was a man of unusual ability and iron will. He wanted his country to be more European—that is, more cultured and developed. He tried to accomplish this result by force of arms and compulsion. Through long and difficult wars, at terrible loss of life and property, he struggled to get control of the outlets to the great Russian plain on which his empire rested. Through violent changes, which tended to demoralize the people, he succeeded in modernizing his administrative machinery; he organized a modern army, and forced education upon his officers and the members of his court, many of whom could not even read. He required all men to register for service in his army, or for the building of canals and roads, for service in his new capital at St. Petersburg (Leningrad) or for work in the factories which he was the first to introduce into Russia. Those who would not or could not do any of these things were required to pay heavy taxes.

A RUSSIAN TREASURE HOUSE OF ART



The Hermitage in Leningrad, founded by Peter the Great and enlarged by Catherine II, contains one of the finest collections of pictures in Europe, and unique treasures of primitive and Greek art from ancient Scythia and the Black Sea coast.

Peter died in 1725. His work survived a half-century of incompetent rulers, after which there came to the throne Catherine II, the Great (1762–1796), who took up again the task of reform. By 1800 Russia had become established as a modern state, and had taken the first steps in internal development, such as the spread of education, the establishment of means of communication, and the manifestation of some regard for the well-being of the people.

During the centuries of struggle the peasants, who represented the overwhelming majority of the people in this agricultural country, had been burdened with so many taxes to the state, and payments of money and labor to private owners of land, that their status had become that of serfs, or unfree laborers. They were not slaves, but they were not free, being "attached to the soil" and to the individual landlords, whom the state thus set up in order to use their services in the government and army. The first task of internal reform was therefore to make easier the lot of the peasants.

Alexander I (1801–1825) entertained very radical and progressive views of reform. He had already commenced to carry out his reform program when Russia became involved in the Napoleonic wars, which were disturbing the peace of all Europe. Reform was then abandoned, and both Alexander and his successor Nicholas I (1825–1855) were driven into a panic by the developments of the revolutions in Europe, and devoted their attention to protecting Russia against what they considered the corrupting and perverting "western" ideas. All interest in the emancipation of the serfs was suppressed as revolutionary, and even discussion of it was forbidden.

For 40 years, from 1815 to 1855, Russia made little progress. All suggestions looking toward admitting the people to a share in the direction of public affairs were ruthlessly suppressed, though these suggestions had at the beginning of the century come from the ruling monarch himself.

Then in 1853 Russia became involved in the Crimean War, a war originally with Turkey, to whose assistance came both England and France. On account of material conditions Russia met complete defeat, although the operations were on her own territory. The government proved incompetent and corrupt. The people were angered by the continued burdens of war, and the peasant serfs rose against the landowners in many places and burned and pillaged estates. These and like disorders, which had been increasing in frequency for years past, assumed threatening proportions during the war.

Before the war was over a new monarch, Alexander II (1855–1881) came to the throne. He brought the war to a conclusion as quickly as possible, and then announced that reform was to be the order of the day,

ABOVE THE CLOUDS IN THE CAUCASUS

This view was taken from the height of 18,465 feet on the eastern one of the twin peaks of Mt. Elbrus, an extinct volcano and the highest mountain in the Caucasus. At its foot lies a glacier, the source of the Kuban River. This lofty ridge marks the division between Europe and Asia Minor.

and that it was to begin with the emancipation of the serfs. He frankly said that it would be better to have this measure carried out from above than to wait for it to be forced upon the government from below. Commissions were appointed to work out the details of the emancipation, and to prepare other liberal reforms, such as the introduction of elective local councils, a new and modern system of law courts, and larger freedom for the press.

The act of emancipation, issued in March 1861, gave liberty to some 40,000,000 serfs. It was to be a gradual emancipation, in order that both landlords and former serfs might have opportunity of readjustment. The lands assigned to the peasants were less than they had formerly occupied, and they were burdened with heavy redemption payments for them for many years; not until 1905 did these payments come to an end. Neither party was fully satisfied with the terms of the act, which however on the whole was liberal and just.

Other reforms followed, introducing the elective local councils (called Zemstvos) and establishing a modern system of law courts for the administration of justice. Thus three great steps were taken toward constitutional government and the protection of the Russian citizen from the arbitrary acts of an autocratic government.

But the long years of tyranny of rulers and lack of progress had produced discontent, particularly among younger persons who had been educated at the universities, of which there were now eight of large size in Russia. Revolutionary agitation and organization developed rapidly. A small group of such revolutionaries tried to organize an uprising of the emancipated serfs. The isolated, suspicious, and uneducated peasants did not respond, and the attempt failed. But the government authorities were aroused, and the influence of those who were antagonistic to reform was strengthened. When an attempt on the life of the czar was made by an individual, acting on his own account, these anti-reform leaders completely prevailed. Under their influence Alexander II curtailed many of the reforms already started, and allowed others to be carried out only in form. Such repression bred more revolutionary sentiment, and soon the government was fully engaged in the suppression of revolutionary agitation, to the neglect of the deeper welfare of the people. The revolutionary movement culminated in the assassination of Alexander II in 1881 by a nitroglycerin bomb hurled at his carriage. He was succeeded by his son Alexander III (1881–1894) who simply continued his father's policy.

The process of emancipation continued now under conditions that did not insure to the peasant even the limited rights that had been granted in 1861. The Zemstvos continued to develop, but too slowly to meet the needs of the people. The third of the great

reforms, the organization of a just administration of the law, was practically abandoned in favor of a return to arbitrary police methods of government. The censorship of the press became more rigid than before. Revolutionary organizations were completely suppressed, but not revolutionary feeling. Discontent grew under persecution, and upon new and increasing grounds.

In 1894, upon the death of Alexander, Nicholas II (1894–1917) succeeded to the throne. Again the educated and progressive leaders hoped that the reform movement might be resumed, particularly as revolutionary activities had practically ceased. The new czar proved, however, to be a man of limited outlook, though possibly of good and kindly intentions. He believed implicitly in the divine origin of his autocratic power, and in its necessity for the welfare of his country. He definitely put an end to all thought of coöperation in reform by calling the petitions for very moderate changes "senseless dreams."

WHERE A CZAR WAS KILLED

This church was built on the exact spot in Leningrad where Alexander II fell on March 13, 1881, when the fatal bomb was thrown, tearing to pieces horses, carriage, and occupants. The bulbous domes, the swelling central arch, and the bold use of ornament mark the Oriental influence so typical of Russian architecture. Throughout Russia this influence contends with the Renaissance style introduced from Western Europe in the 18th century.

In 1904 Russia and Japan went to war over a dispute respecting rights in the Far East (*see* Russo-Japanese War). The war was not popular in Russia; and when defeat, largely because of the corruption and incompetence of the government, met her armies, and the war was concluded on terms most disadvantageous to Russia, the revolutionary movement began again. A factory laboring class, quite distinct from the peasants, had now arisen and it was organized for action by socialists and revolutionists. Peasants sympathized and helped. There were many mutinies in the army and fleet also. In this emergency progressive manufacturers and landlords demanded measures of reform which would satisfy the just demands of workmen, peasants, and soldiers. Partially successful, they secured at last an elected representative national assembly, called the Duma; but only after a general strike, supported by all classes in the community, and continuing for a week.

The first Duma was convened in 1906. The champions of autocracy were able to bring about its early dissolution. A second Duma was similarly dissolved after a short session, and the election law was changed by the government in such a way as to give the majority of the seats to the large manufacturing interests and the landlords. Though not fully representative, and limited in its powers, the Duma was an important step toward constitutional government. Dominated by property interests, it nevertheless attempted to bring about much-needed reforms, to exercise control over the government, and to protect individuals from arbitrary acts by government officials. The Duma was elected from the people by a group system of voting which secured privileged representation to landlords and manufacturers, and very limited representation to the peasants, workmen, and professional groups. Its sanction was required for the passing of any law, but it had no control over the governmental machinery for the carrying out of the law.

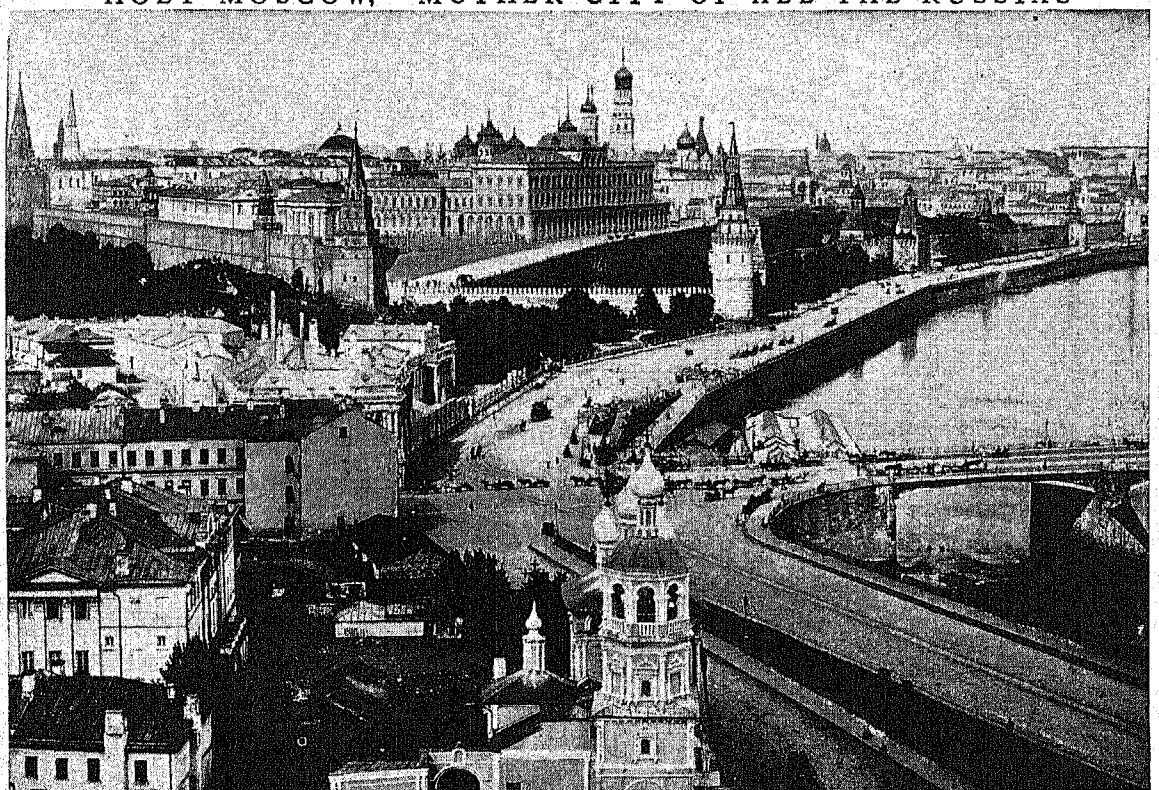
The First World War and Russia

The summer of 1914 saw fresh manifestations of discontent in Russia. Meetings of progressives and liberals, at which resolutions were passed demanding many reforms, were held, and strikes of unusual proportions developed in industrial centers. Revo-

PETER THE GREAT'S "WINDOW TOWARD THE WEST"

Leningrad (then called St. Petersburg) was founded in 1703 by Peter the Great, to give Russia an outlook upon western Europe. We have here a winter scene in the city. On the right is the golden dome of St. Isaac's Cathedral, one of the most splendid churches in the world, with rich mosaics and red granite columns. The Soviet government has made it an anti-religious museum.

"HOLY MOSCOW," MOTHER CITY OF ALL THE RUSSIAS



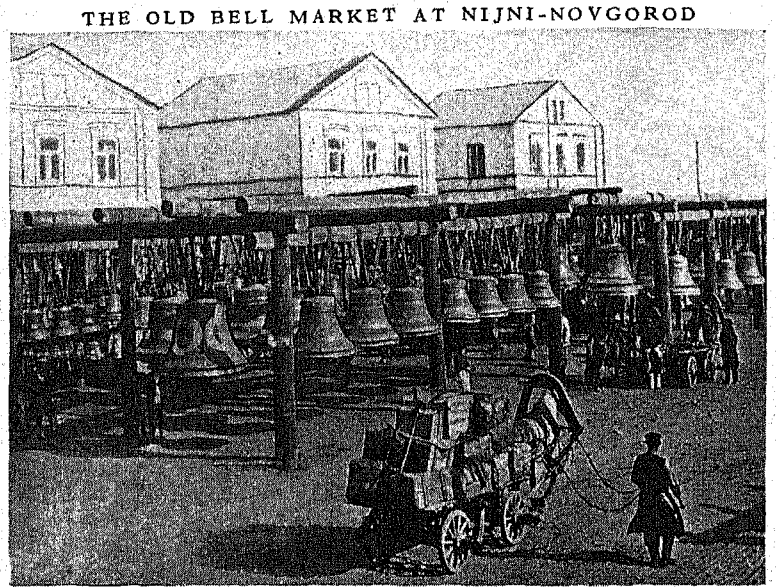
This is the Moscow of spires and steeples, which we see as we look out over the city from the Church of the Savior. In the background are the towered and battlemented walls of the Kremlin, an ancient stronghold in which Moscow was cradled. Within the Kremlin's walls are majestic palaces and picturesque cathedrals, once used by czars and nobles. Today the Kremlin is the center of the Soviet government. On the right flows the Moskva River.

lutionary organizations long since supposedly suppressed made themselves evident. In this atmosphere of unrest came the news of the outbreak of the World War, in August 1914 (*see* World War of 1914–1918). To well-informed observers it was no surprise. The relations between Russia and Germany, and between Russia and Austria, had been strained for several years past. Russia claimed special interests in the Balkans, which were imperiled by Austrian and German policies. There was also German influence inside Russia, especially in court circles, which was believed to be hostile to reform. This helped to make the war an internal as well as an external one, in the minds of the educated classes. Peasants and workmen at first accepted it without protest; but even among the masses there soon developed the consciousness that the war was a war for liberation, not from aggressive neighbors alone, but from internal tyranny. However, all outward opposition to the government was submerged in the effort of the people as a whole to present a solid front to the enemy.

Russia felt the crushing burdens of the war sooner than other countries. Her economic backwardness and particularly her poor means of communication made her war efforts very costly. Her chief ports of communication with the West, and therefore with her Allies, were shut off from the first day of the war. In spite of such use as could be made of Archangel during the summer season and the construction of a new railway to Alexandrovsk on the ice-free Murman coast of the Arctic Ocean Russia was subjected to a blockade almost as effective as that against the Central Powers; and Russia had always depended more largely than they upon foreign supplies. In this crisis, as many times before, the government proved itself incompetent and corrupt. The most progressive men of the country came forward with offers of assistance to the government in dealing with the problems of the war, but their offers were rejected. The government feared to grant popular participation in public affairs, lest this freedom might lead to permanent embarrassment of the autocratic methods of the government. Great military disasters came to Russia as the result of the failure of the government to supply and equip the armies. Literally millions of Russian lives were sacrificed.

As a result, the attitude of the public toward the government changed, and there were demands—insistent but moderate and genuinely patriotic, and well grounded—for reforms, which alone would enable the nation to carry on the war. The sovereign listened only to the selfish advice of individuals in his immediate government circle, and interpreted all demands as either groundless or definitely unpatriotic. With his approval the government interfered in every way with the activities of the Duma and with the work of special organizations of the people, even those whose activities represented such genuine war work as the care of the wounded. The government's attitude was one of suspicion toward all movements initiated by the people.

THE OLD BELL MARKET AT NIJNI-NOVGOROD



Even a modern department store can scarcely parallel this exhibit of merchandise at Nijni-Novgorod (now Gorky) in the days of the old fair.

By 1916 internal discontent, especially in the large cities, had swelled to alarming proportions. The food situation had become critical and prices on manufactured goods had risen to absurd heights. Again attempts were made to secure by petitions political changes which would better conditions, but again the sovereign refused to pay heed.

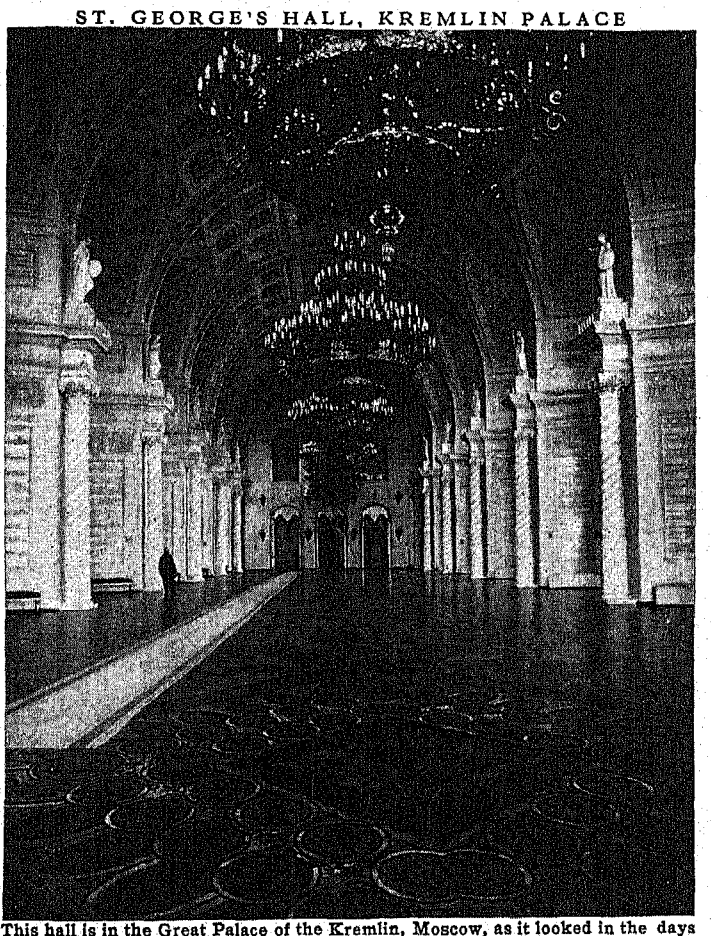
At Last the Government Collapses

In March 1917 a bad food shortage in Petrograd brought demonstrations of protest accompanied by riots, and the soldiers went over to the people, deserting the government. The Duma, in session at the time although daily expecting dissolution by the government, alarmed by the street riot in the capital, resolved to act to save the situation. They organized a temporary provisional government which was representative in character, and sent a delegation to the czar demanding his immediate abdication. The socialist members of the Duma organized a council of deputies from the workmen and soldiers of Petrograd. This council or "Soviet" (as it was called in Russian) coöperated with the Duma committee in the selection of this first revolutionary government, and in drawing up its platform. Nicholas II abdicated for himself and his son (March 15), and was put under arrest. He and his family were sent to a distant Siberian

monastery and in a very short time this last of the Russian czars was practically forgotten.

This revolution of March 1917 was accomplished within a week. The former government machinery in Petrograd collapsed utterly. The rest of the country, and particularly the army, promptly submitted to the new authority. There was little bloodshed, and the revolution was hailed with joy throughout Russia. For a time the government was in the hands of the nonsocialist Constitutional Democrats, but in July the power passed to Alexander Kerensky, a brilliant orator of moderate socialist views.

ST. GEORGE'S HALL, KREMLIN PALACE



This hall is in the Great Palace of the Kremlin, Moscow, as it looked in the days of the Czars. It is 200 feet long, 58 feet wide, and 70 feet high. Its decorations were in white and gold, the enormous chandeliers of gold, and the polished floor inlaid with the richest woods of the empire.

The provisional government had to face a difficult situation. It was one of the most critical moments of the great war without, and conditions were extremely bad within. The leaders determined, however, that the war must be carried on with even greater vigor. A program particularly favorable to the demands of labor and of the peasants was drawn up; but the executive machinery of the new government was not sufficiently perfected, and the people, unaccustomed to political responsibility, did not act as a unit. The economic situation was too bad to be immediately improved, and there were many differing opinions as to the best policy with respect to the war. To continue the conflict meant to increase burdens already heavy. The Russian people were tired out, especially the peasants, and their losses in lives had already reached into the millions.

The Bolsheviks

At this point there came forward a small group of extreme socialists, to many of whom the recent revolution had given the opportunity to return from exile in foreign lands. They urged withdrawal from the war and a new revolution of another kind, a social revolution, the aim of which was to overthrow completely the existing social and economic system, and to establish a new order based on the principles of communism. This kind of revolution would abolish all private property, and establish a dictatorship of the proletariat or workmen. The instrument for such a revolution was to be the "Soviet of Workmen's, Peasants', and Soldiers' Deputies" which had been organized throughout the country, on the model of the one established in Petrograd at the time of the first revolution in March.

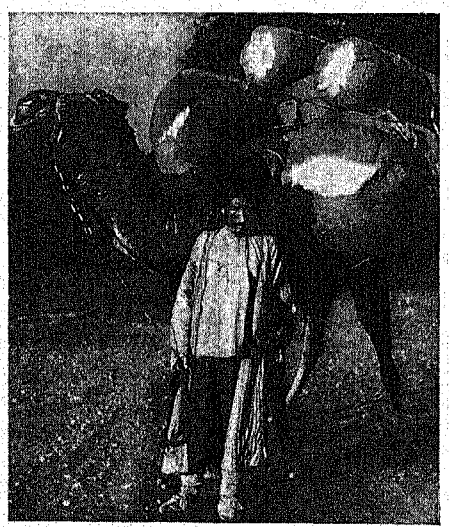
During the summer of 1917 the champions of this new revolution—the Bolsheviks as they were called—carried on active propaganda among workmen, soldiers, and peasants. They promised peace through the immediate withdrawal of Russia from the war, and to the peasants land through the confiscation of landlord estates, and bread to the workmen through the seizure of the factories. The economic distress and the confusion of mind that existed during these months furnished a fertile soil for this propaganda. Finally on November 7 the Bolsheviks overthrew the provisional government and drove Kerensky from Petrograd. Unlike its predecessor, this was not a bloodless revolution. Riots, assassinations, and measures as autocratic as any in which the czars had indulged were used to further the purposes of the Bolsheviks. The new government which they set up was called "the Russian Socialistic Federated Republic of Soviets." Eight months later the former czar and his whole family—wife, son, and daughters—were brutally shot to death by the Ural regional Soviet (July 17, 1918).

The first political step of the new Soviet government was to arrange an armistice with the Central Powers.

Peace negotiations were soon started, and in March 1918 the Peace of Brest-Litovsk, entailing a separate peace between Russia and the Central Powers, was signed. The Bolsheviks then set about carrying out their revolutionary program. Those that opposed them—even by force of arms—also opposed the peace with Germany which they had signed. On this basis the Allies rendered assistance to the anti-Bolshevist movements. Also the Russian Bolsheviks had proclaimed as their goal a world revolution, of which the one in Russia was to be the first step. This constituted a challenge to other nations, and some, including the United States, refused to recognize the new government.

RUSSIA CATCHES UP—
NEW WAYS OF A NEW RÉGIME

A nation far behind the modern world in efficiency, Russia under the Soviet régime is trying hard to catch up. Above we see a class of adults learning to write. In the center, an American expert is showing a Russian workman how to make watches. Below is a native of Turkmenistan with a load of cotton, the production of which has been greatly increased.



The new Russian state had from the beginning the class principle as opposed to the democratic principle as the basis of the political structure. It was a "toilers' state," the new rulers being the industrial workmen. This economic class became the standard-bearer of the revolutionary principles. As a class without property it was to abolish private property. The land also was nationalized; the peasants merely had the use of it.

The Communist party, which included only a little more than one per cent of the total population, was the only political organization permitted. It constituted in fact a dictatorship in the name of the workman class. Admission to the party was carefully controlled, and a rigid discipline was exercised over the members.

The state was federal in organization. Non-Russian national minorities were given independence or autonomy within the Union, with freedom to use their native languages and develop their peculiar national cultures. But the principle of nationality was subordinated always to that of class. The Communist party dominated everything. Also the Russian unit, centering in Moscow, continued to be the ruling member of the Union, because of its size and larger population.

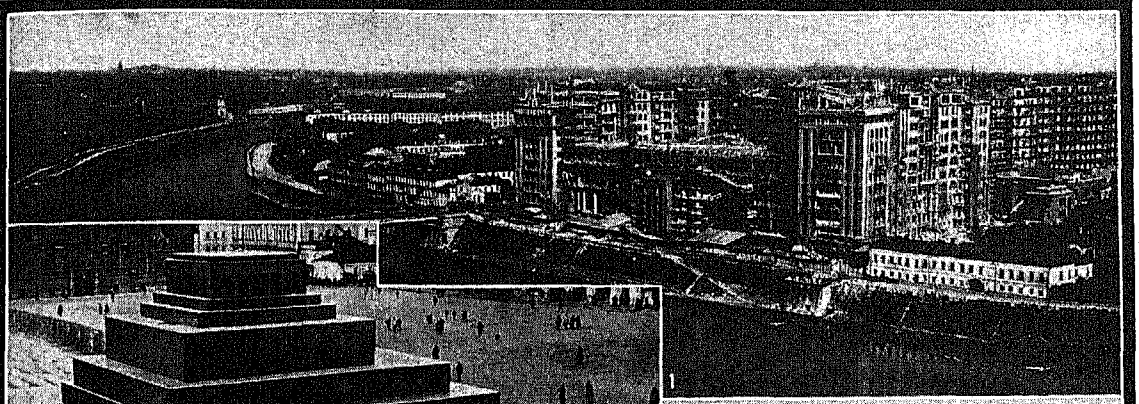
The governmental organization of the Soviet state was built like a pyramid. At the bottom were the local soviets, designed to represent the productive life of the country directly. Each village elected a soviet, or council. The village soviets sent delegates to a township soviet, which elected an executive committee with full administrative power within its jurisdiction. Likewise, delegates from industrial areas assembled in the city soviets. Delegates from village and city soviets met in district and provincial congresses; and so the pyramid mounted, reaching the pinnacle in the All-Union Congress of Soviets, which was the supreme authority. It met at least once in two years. Between congresses the highest authority was the Central Executive Committee, which met three times a year, and between its meetings business was transacted by the presidium of the Central Executive Committee. There was a similar governmental scheme in each of the constituent and autonomous republics, and in the various autonomous areas.

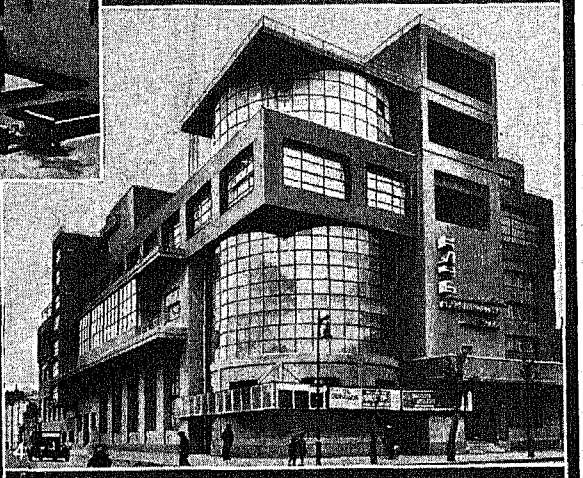
Lenin, Trotzky, and Stalin

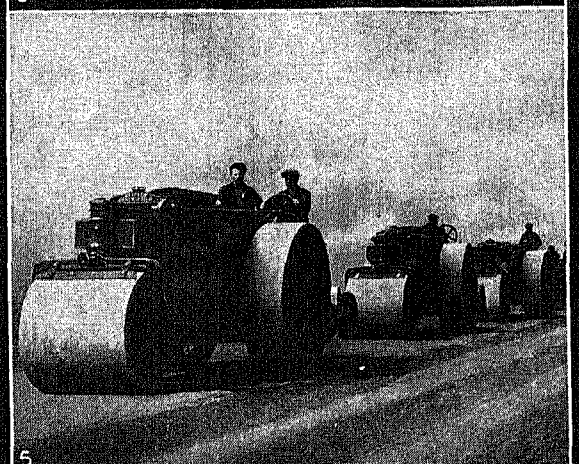
Nikolai Lenin, the original leader of the Revolution, died in 1924, but his assistants carried on in his name and followed his teachings (*see* Lenin, Nikolai). Most prominent of the leaders were Leon Trotzky (*see* Trotzky, Leon) and Joseph Stalin Djugashvilli (*see* Stalin, Joseph). These strong and forceful personalities clashed in temperament and also over matters of policy. Stalin, "the man of steel," emerged victorious. Trotzky was exiled, and Stalin became the leader, virtually the dictator, of the Communist state.

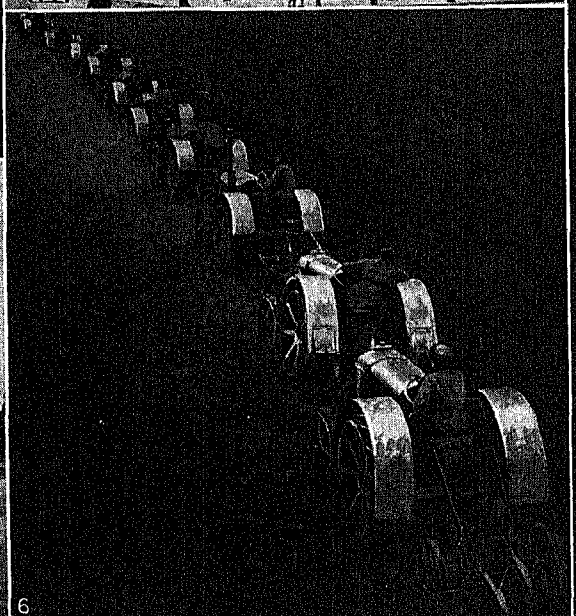
The early years of the Soviet régime saw a complete breakdown of industry, transportation, and agriculture. By 1921 the whole nation faced starvation, and the government was forced to adopt the "New Eco-

LIFE UNDER THE COMMUNIST SOCIAL SYSTEM









1. On one side of the Moskva River in Moscow glitters the Kremlin, symbol of the old régime. On the other rise these huge apartment houses for the employees of central government institutions. 2. To the Communists the holiest spot in Russia is the tomb of Lenin, built of stern granite, in the Red Square, Moscow. Thousands file past the body daily. 3. Hot dinners are served in the fields to peasants on a communal farm in Uzbekistan, from a severely efficient traveling kitchen. 4. Workers must play as well as work, according to Communist doctrine. This communal workers' Trade Union Club, of strictly modern design, in Moscow, is one of many such recreational centers for the entertainment of the laboring class. The programs include film plays, lectures, radio entertainment, music, and dancing. 5. These great rollers are giving Russia a network of good roads. 6. The Soviet régime has always glorified the machine, particularly the powerful tractors which speed up agriculture on the state and coöperative farms.

WOMEN AND CHILDREN IN SOVIET RUSSIA

Freedom from veils and from illiteracy is offered women in the oriental parts of Soviet Russia. Here we see a young Communist teaching women of Turkmenistan to read and write. A strange ferment of ideas must seethe under those tall caps.

nomic Policy" (NEP). This involved dropping many Communist principles. Money, which had become practically worthless, was reintroduced, and put on a gold basis; private trading was allowed within certain limits, and the wage system was restored. Industry revived, and many people believed these changes would end "the Russian experiment."

But the government was only waiting until it felt strong enough to resume its program. Year by year its forces were strengthened as the younger generation grew up, trained in Communist principles by the schools. By 1928 it was ready to renew the drive for Communism. After banishing Trotzky, who clung to the idea of working for "world revolution," the Stalin government set itself to reorganizing Russian agriculture and industries on Communist lines.

It is not unusual in modern Russia to see a woman, like this Siberian girl, doing blacksmithing.

The First "Five-Year Plan"

Stalin's program, started in 1928 as the first "Five-Year Plan," called for creating mines, mills, factories, and transportation enough so that Russia could produce all the materials and machinery needed to build a complete "machine age" civilization. The entire country was mobilized behind this program, and the political police (OGPU) ruthlessly suppressed all objectors. But great difficulties had to be overcome. Foreign machinery and foreign experts were needed, and had to be paid for. Russia's only chance to pay lay in exporting raw materials, principally foodstuffs. This meant that the peasants must produce a surplus, even though they were not producing enough to feed themselves and the rest of the country.

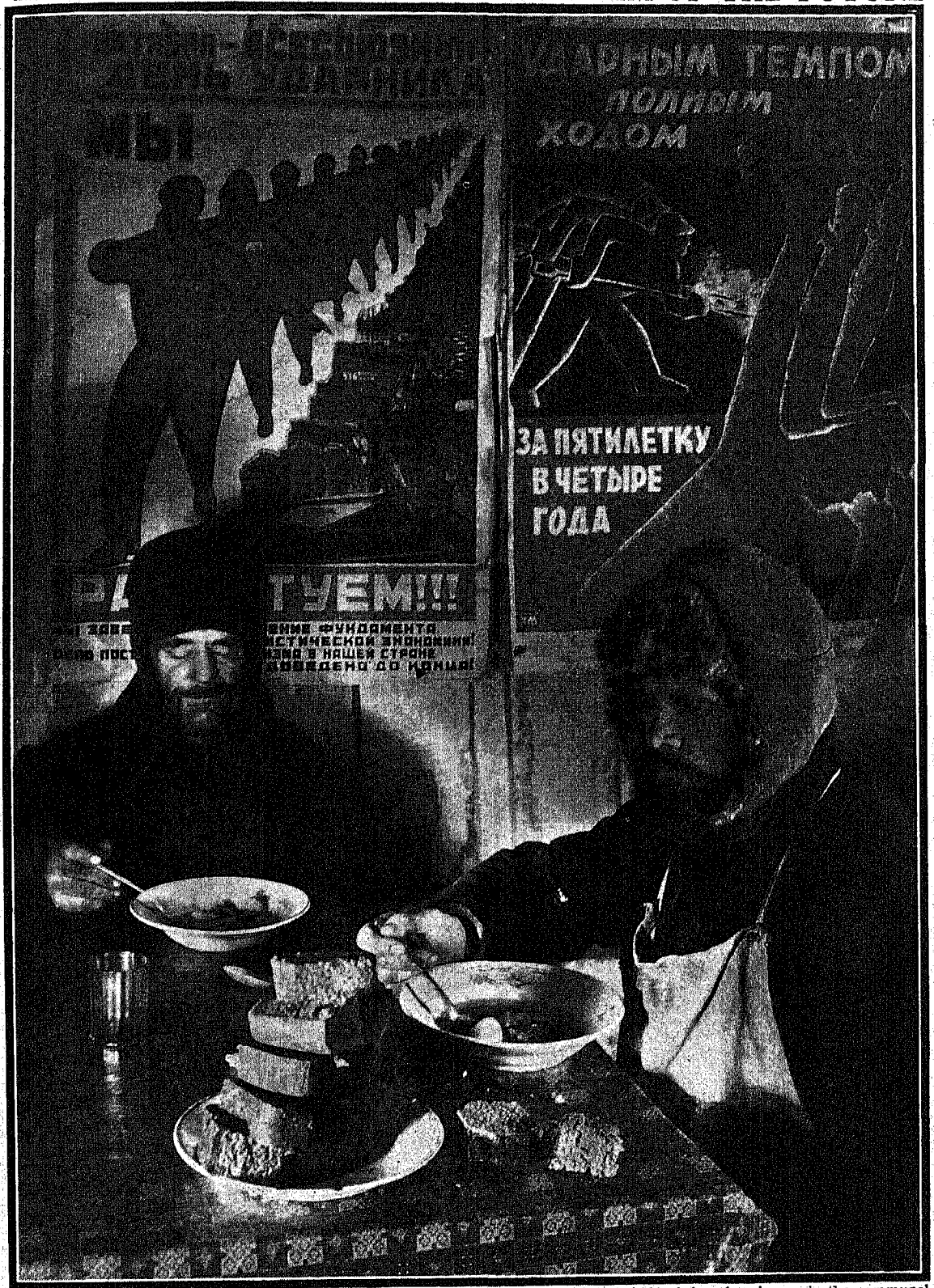
The Attempt to Communize Farming

Huge "state farms" were established under government management. Other peasants were encouraged to "pool" their land and belongings into "collective farms" (*see* Agriculture), which the government undertook to supply with machinery, good seed, and live stock. The *kulaks* (richer peasants) were driven from their farms, and many were banished to distant lumber camps.

Production was slow in increasing. The government took a large share of the crops, and the discontented peasants retaliated by planting smaller crops, letting weeds run wild, butchering their live stock, and by other methods of passive resistance.

The city workers felt the pinch even more than the peasants. Under the Communist plan, every city worker had a food card, entitling him to obtain supplies at government stores. Factory workers and members of the Communist party obtained the most generous rations. If others wanted to increase their scanty rations,

"We will play while our mothers work" reads the banner of the children being cared for in a village coöperative nursery while their mothers plow the fields.



Under posters that urge workers to speed up production, two bricklayers sit eating their black bread and soup in the communal kitchen at Magnitogorsk. This fine study was made by the noted American photographer Margaret Bourke-White.

they had to buy in "open markets" where the NEP permitted peasants to sell any surplus they managed to produce. But now there was no surplus of food for sale. Supplies of clothing and other "consumers' goods" were also insufficient.

In 1931 the original Soviet plan of paying all workers the same wage had been changed to payment according to skill and output. The five-day week adopted at first was changed to six days; then, to speed up production, the seven-day week of the Western world was adopted in 1940, with Sunday as a free day.

Progress in Industry and Transportation

In 1933 the government announced a second Five-Year Plan, designed especially to improve living conditions. Production of capital goods was to be slowed down and more goods produced for the consumer. After two large harvests, restrictions on the sale of foodstuffs were removed, food cards were abolished, and prices were reduced.

Production in many lines was greatly increased. Russia became an exporter of cotton instead of an importer, and regained its position as the world's largest producer of manganese. It was second only to the United States in its output of pig iron. Coal, iron, steel, and petroleum production ran well ahead of the five-year schedule. A program of railroad building was laid out, to extend and modernize the utterly inadequate and inefficient system. A 1,700-mile line from Siberia to Turkestan was laid. A number of branch lines, particularly in the newly industrialized areas of the Urals and western Siberia, were constructed, and the Trans-Siberian line was double-tracked. Many additional canals were built. A sea route was opened in the Arctic Ocean so that the Soviet lands of that region could be developed. A number of ports were built at the mouths of the Siberian rivers. In 1937 an aviation base was set up on an ice floe near the North Pole and experimental flights were made from Moscow over the Pole to the United States. In 1938 the third Five-Year Plan was launched, calling for a 38 per cent increase in national production by 1943 and particularly emphasizing the development of Asiatic Russia.

The Stakhanovist Movement

In all Soviet industries a new speed-up system was introduced. It was named after Stakhanov, a coal miner who originated it. Under his method, teamwork is carried on by pooling the special skills of a group of workers in the performance of a task. Stakhanovism caught the imagination of the masses and was encouraged by the leaders. It resulted in increased output at a higher rate of pay.

Rights for Workers and for Women

The constitution of 1936 guaranteed to every citizen the right to a job, fair wages, an annual vacation with pay, free medical aid, and pensions for sickness and old age. The seven-hour working day then in effect was changed in 1940 to eight hours for most workers, to increase production for national defense.

In the earlier years of the revolution the conditions of family life had been lax. This was changed by legislation making marriage easier and divorce more difficult. Although the immediate object was to protect the woman, it was held that the building of the country's economic and social security called for the wholehearted coöperation of stable family units.

In the constitution of 1936 it was stated that woman enjoyed equality in all walks of Soviet life, economic, political, social, and cultural. State aid was guaranteed for mother and child, in the form of special leaves of absence with pay and free care in lying-in hospitals for women workers, and day nurseries and playgrounds for children. The Institute for the Protection of Women and Children coördinated the work of all the social agencies in this field.

Education and Culture

Great emphasis was laid on education and culture. Primary and high-school education was made compulsory for both sexes. The 1936 constitution, through a system of state scholarships, as well as by other means, guaranteed to citizens the right to education, including higher, technical, and other special forms. Instruction in factual knowledge was emphasized, rather than the teaching of abstract doctrine, as in the earlier era of the Soviet régime. Discipline was again stressed.

Museums, libraries, concert halls, reading rooms, and clubs were established in ever-mounting numbers. Drama and opera at Moscow were brought to an unusual degree of excellence. Newspapers, books, and magazines multiplied. Radio and motion pictures were promoted as instruments for spreading Communist ideas, especially in the rural areas.

The government gave new impetus to scientific research by providing facilities for scholars in all branches of knowledge. It built and equipped laboratories, established new institutes, and sent out expeditions.

Patriotism and International Status

Since the Soviet Union, according to Stalin and his followers, is proving that socialism is possible in one country alone, nationalism and love of country were actively fostered. Relations with other countries had long been disturbed by the world-wide activity of the Third International. They improved, however, when militant internationalism of the kind Trotzky had advocated ceased to be supported by the leaders at Moscow. In 1933 the Soviet government was recognized by the United States and in 1934 Russia joined the League of Nations to promote disarmament and peace.

But advocates of the principle that Russia should take an active rôle in spreading revolution to other countries still remained. The extent to which the Communist party was divided on this question was dramatically revealed by a series of "purges" in 1936–38. Many prominent officials and military leaders were brought to trial on charges that their opposition to Stalin's policies had led them to plot to betray the Soviet Union into the hands of foreign coun-

tries. Some confessed guilt, and scores were shot or imprisoned, among them some of the best known of the "Old Bolshevists." Especially astonishing was the execution of eight generals, including Marshal Tukhachevsky, vice-commissar of war. Although the "purges" cost the country many able leaders, they also nipped the threat of a "fifth column" in the event of foreign attack and left Stalin undisputed master.

THE SOVIET ARMY MARCHES IN RED SQUARE, MOSCOW

Infantrymen with fixed bayonets march past portraits of Lenin and Stalin in a May Day parade. Russia's army, largest in the world, met its great test in 1941, when Germany invaded the Soviet Union. It astonished the Nazis by its remarkable fighting ability and its skillful leadership.

New Constitution

In December 1936 a new constitution for the Soviet Union was proclaimed to replace the constitution of 1924, which had been considered temporary. This constitution defines Russia as a socialist state of workers and peasants, with their soviets as the political basis of the nation. Means of production are declared to be the property of the state, but citizens have the right to limited kinds and quantities of personal property, with provision for inheritance. The constitution announces that the capitalist system of economy no longer exists and that exploitation of man by man is abolished.

Labor, it states, is the duty of every able-bodied citizen, and "he who does not work, neither shall he eat." It says further: "The principle applied in the U.S.S.R. is that of socialism: 'From each according to his ability, to each according to his work.'"

The Union is a federal state of soviet socialist republics having equal rights. The Union has authority in certain matters, but in all others the republics act independently. Their constitutions are, however, drafted in conformity with the federal constitution.

The highest organ of legislation and administration is the Supreme Soviet. It has two chambers: the Soviet of the Union, representing the population at large; and the Soviet of Nationalities, representing the constituent units. At a joint meeting the two chambers elect the Presidium. This body calls and dissolves sessions of the Supreme Soviet, calls new elections if the two chambers disagree and cannot be brought to agreement, and appoints the higher commands of the armed forces. It appoints diplomatic representatives, ratifies treaties, and, between sessions of the Supreme Soviet, may declare war. The Presidium amounts to a "collective presidency," and its president is the titular head of the state. The Supreme Soviet also appoints the Council of People's Commissars, which is the Union's highest executive authority. The commissars are in effect a ministry, responsible only to the Supreme Soviet.

Courts are elected for limited terms. Highest is the Supreme Court of the U.S.S.R., which is elected by the Supreme Soviet. Territorial and regional courts are elected by the regional soviets, and people's courts are elected by direct vote of the citizens of the districts.

Many of the liberal provisions of the new constitution were restricted in practise by the one-party system. This system, prescribed by basic Communist doctrine, kept the power to formulate policies, to propose or interpret legislation, and to direct executive action under the strict control of the Communist party leaders, headed by Joseph Stalin. Thus, much of the new constitutional machinery could deal only with administrative details.

The new constitution contained guarantees of freedom of speech, of the press, and of religion. But these freedoms too could be exercised only insofar as they did not conflict with the strictly defined aims and policies of the governing party.

Foreign Policy

For 15 years after the Bolshevist revolution, the Soviet nation, hated by the rest of the world and confronted with staggering problems at home, pursued a policy of isolation. In 1934, however, after it entered the League of Nations, Russia resumed an active rôle in world affairs.

From the start it vigorously espoused "collective security," whereby the aggression of any one nation would be met with the resistance of all. To reinforce this policy, in 1935 it signed a mutual defense pact with France, binding each country to aid the other if attacked. A similar pact was signed with Czechoslovakia. Germany and Italy countered this move by forming

an alliance, called "the Rome-Berlin axis." This was later widened into an anti-Comintern (anti-communist) pact which included Japan and other countries.

Conflicts with Germany, Italy, and Japan

The next few years provided many tests of power between Russia and the anti-Comintern nations. In 1936, when civil war broke out in Spain, Russia aided the republican government with arms and specialists, while Italy and Germany sent troops and supplies to the fascist rebels (*see* Spain). In 1937, when Japan launched an "undeclared war" against China, Russia aided Chinese resistance. In 1938 Russia pledged military support to Czechoslovakia if it should choose to resist Germany's territorial demands; but France and England, excluding Russia from the negotiations, sacrificed Czechoslovakia to Germany in the Munich Pact (*see* Czechoslovakia).

In an effort to avert a threatened German attack on Poland, England and France in 1939 attempted to bring Russia into a "stop Hitler" alliance. When negotiations reached a deadlock, Russia, completely reversing its previous policy, signed a ten-year nonaggression pact with Germany in August 1939. Germany then sent its troops into Poland, bringing war with England and France.

Extension of Soviet Territory

At the outset, Russia's aims were to remain neutral in the war, which it condemned as "imperialistic," and to improve its own military position against the possibility of attack by either side.

In September it joined Germany in invading Poland and later in partitioning it (*see* Poland). Then it exacted far-reaching military and trade concessions from Lithuania, Latvia, and Esthonia. When Finland refused to grant similar concessions, Russia invaded the country in November, and by March 1940 forced Finland to agree to a peace treaty which granted the Soviet Union a large slice of Finnish territory (*see* Finland). In June it compelled Rumania to return Bessarabia and to cede northern Bukovina (*see* Rumania). And in August it completed its domination of the eastern Baltic by incorporating Esthonia, Latvia, and Lithuania as new republics of the Soviet Union (*see* articles on these countries).

War with Germany

The long-feared attack from the west came suddenly on June 22, 1941, when Germany, without warning or ultimatum, invaded the Soviet Union. Into the war against Russia, Germany also drew Italy, Finland, Rumania, and Hungary. From Great Britain, itself fighting German aggression, and from the United States too, Russia received assurances of material support.

But more than British and American aid and more even than its huge military forces, Russia counted on its vast size to defeat the invaders. Soviet leaders vowed that Hitler, like Napoleon, would meet his doom in the broad expanse of Russia. (*See also* World War, Second; Communism; and **Russia** in FACT-INDEX at the end of this volume.)

—REFERENCE-OUTLINE *for Organized Study of* RUSSIA, POLAND, *and* THE BALTIC STATES—

RUSSIA, the last of the European states to come under the influence of Western civilization, is still almost a stranger among the others. Indeed, Russia belongs as much to Asia as it does to Europe. The ambitions of its former rulers led them to seek a place in the affairs of the Western powers, but fundamentally Russia continued to be a nation apart.

The empire had been built on a grand scale. Borders were expanded until Russian territory stretched from central Europe across Asia to the Pacific, and from the Arctic to the borders of Persia and Afghanistan. A highly cultivated aristocracy grew up in the metropolitan centers amid lavish extravagance. But, in contrast, the masses were pitiably neglected. The country's rich natural resources remained practically unexploited. Industrial development had scarcely begun, and transportation was entirely inadequate.

When the Revolution of 1917 overthrew the czar and the whole structure of the imperial government, the bonds with Western Europe were broken, and Russia retired within itself, faced with the enormous problem of rebuilding a government from the very foundation. The Russian people had little spirit of unity and no experience with the broad problems of self-government.

With these handicaps, the Bolshevist leaders launched an experiment in mass rule such as had never been attempted before. The Soviet government undertook an ambitious plan designed to turn this huge, backward, agricultural country into an industrial nation of the most advanced type. Unique educational and social projects were fostered, and appreciation and development of the arts became a matter of national concern.

The collapse of the czarist and Hapsburg empires brought insistent demands for independence from national groups within those empires. Poland and the Baltic States enjoyed brief independence, but in 1939–40 Soviet Russia regained most of its old territories—only to lose these gains during the war with Germany in 1941.

This outline deals with the Union of Soviet Socialist Republics, with the Baltic States, and with Poland.

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The GRIM, EXALTED *Spirit of the* RUSSIAN WRITERS

RUSSIAN LITERATURE. Born under the yoke of tyranny, the master writers of the 19th century, the "golden age" of Russian literature, were compelled to struggle against ignorance, superstition, and persecution. If they painted too vividly the sufferings of the peasants, the corruption in official circles, or the leaden weight of the Russian church, they were in danger of imprisonment or exile to Siberia.

Yet this attitude of the government merely gave a keener edge to social and political questionings, and sharpened the pens of the writers. It thus prepared the way for the Revolution of 1917, which hurled the czar from his throne.

LOMONOSOF
Father of Russian Literature

Russian is considered next to Chinese the most difficult tongue for foreigners to master. Its grammar is intricate, and it is written with the Cyrillic alphabet, derived in the 9th century from the capital letters of the Greek alphabet, with the addition of several arbitrary characters.

There are three branches in the Russian group of languages: (1) Great Russian, which is spoken in the north, central, and east, and was the official language of the whole Russian Empire; (2) Little Russian, the language of the Ukraine in south Russia; and (3) White Russian, which merges into Polish in the west. Of these, Great Russian alone has been developed and enriched to the point where it has produced a truly great literature. It is chief among the Slavic languages, which include also Polish, Czech, Croatian, Bulgarian, Slovenian, Serbian, and many other tongues.

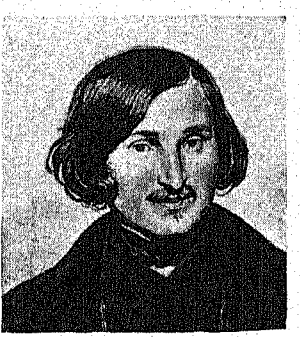
PUSHKIN
Byronic National Poet

Great Russian had its origin in the old Slavic language, still used in the Russian church. It bears the same relation to modern Russian as Latin does to French or Italian. In this language were written 'The Chronicle of Nestor' and 'The Story of the Raid of Prince Igor', the earliest and best of the primitive epics set down in writing. They date back to the 11th and 12th centuries, when Kiev in the southwest was the center of culture.

But in the 13th century, the Golden Horde of Tatars conquered Russia and for over two centuries froze Russian intellectual and artistic life, building an invisible but real wall between this nation and Europe. Then, as the new Russian nation formed around the Grand Dukes of Moscow, the intolerant despotism of the new czardom effectually throttled all literary endeavor until the 18th century.

Ideas from Europe

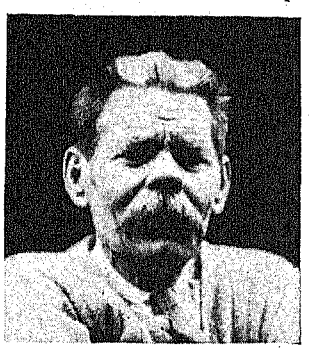
Russia, however, could not remain forever cut off from Europe. First from Poland, then from Germany, and later from France and England, the wind of new ideas began to blow. The movement to Europeanize the backward country begun by Peter the Great at the beginning of the 18th century and carried on by Catherine II, the forceful and witty empress of German birth, made the French language and ideas fashionable in St. Petersburg (Leningrad). Meanwhile the versatile genius Mikhail Lomonosof had written the first Russian grammar, and won the title of "the father of Russian literature." The first voice from Russia heard outside was that of Alexander Pushkin, "the uncrowned czar of Russian poetry," in the 19th century.



GOGOL
Founder of Russian Realism

Since Puskhin, Russian literature has constantly been a force to reckon with in world literature. In no

field has it accomplished more than in the realistic novel, of which Nikolai Gogol, with his amusing pictures of the Russian country gentry, was one of the founders. Among the great novelists was Turgenief, master of realistic prose; Dostoyefsky, student of the human soul who has influenced all modern "psychoanalytic" literature; and the giant, Leo Tolstoy, at once great social reformer and penetrating artist. Master of wit and tragedy was Chekhof, both in plays and short stories. Gorky, vivid and colorful narrator of the seamy side of life, championed the poor and oppressed, presaging the Revolution and its literature. Andréef, the eccentric but powerful mystic, wrote chilling plays and tales of horror.



GORKY
Defender of the Under-Dog

Throughout the work of these writers may be heard the thunders of the oncoming Revolution. In the first half of the 19th century, the cry of liberty and social reform came from the "intellectual" aristocrats. From 1850 to 1870 the cry was taken up by the middle class, the student element, and the "nihilist" movement began, with its appeal to reason and science. Then came the "populist" period, idealizing the great peasant class. When the ignorant and superstitious peasant proved indifferent to visions of a better future, a spirit of reaction and despair set in. The 90's saw symbolism reach Russia from Europe. Alexander Blok was perhaps greatest of the symbolist poets, while Feodor Sologub produced, besides symbolist verse, one of the finest novels since Dostoyefsky, 'The Little Demon'. Andrey Byely, who also began as a poet of the younger Symbolist School, revolutionized Russian prose, notably in 'The Silver Dove' and 'Moscow', both novels. Associated with him in the improvement of the Russian language as a literary vehicle was Alexis Remizof.

BABEL
Writer of Cavalry Tales

Revolution and Writers

Gorky had long been the voice of the workers, and his books contributed to the destructive mood of the Revolution. Yet when the new régime arose, he wavered for years before allying himself with it, while Andréef died in poverty and want, a voluntary exile in Finland. Blok accepted the new order wholeheartedly. Russia's agony from 1917 to 1921, the Communist effort to "liquidate illiteracy," and the new social ideas, brought writers from the submerged classes, with fresh viewpoint and strength. First were the "futurists," vague in style and scornful of grammar. Except for Mayakofsky, the poet, they were soon forgotten. Demyan Byedny, journalist-poet, enjoyed favor with the revolutionists for his facile propaganda in rhyme.

A large group of writers from all classes, named by Trotzky the "poputchiki," or "the Fellow-Travelers," because, while not completely Communistic in beliefs, they were willing to "travel along" with the Revolution, became prominent around 1921. In this year was published the first novel of Boris Pilnyak, best known of this group. Others were Vsevolod Ivanof, born in the Kirghiz steppes; Lydia Seifullina, a peasant woman who portrayed peasants as primitive brutes; the peasant poet, Sergei Yessenin, husband of Isadora Duncan; and Isaac Babel, whose vivid tales of the Red cavalry are the best literary work of the group. Their tendency was to great abstractness, to movement of masses rather than to play of individual character. "Revolution" was their hero. Only partially associated with the Fellow-Travelers was Leonid Leonof, more conservative both in style and subject. The Five-Year Plan gave the Russians a new abstract "hero," that of industrialization, glorified in the novels of Feodor Gladkof and Sergei Semenof.

SEIFULLINA
Portrayer of Peasants

Russian writing both before and after the Revolution has a bitter and acrid flavor, yet there is no denying the power of the art of these people, who stand halfway between Orient and Occident. Their grim, exalted spirit has made its way into the modern literature of every land, and no writers have excelled the Russians in intensity and human insight and in a certain vigor of expression that is typical.

CHIEF FIGURES IN RUSSIAN LITERATURE

Mikhail Lomonosof (1711–1765), poet and grammarian—"father of Russian literature."
Nikolai Karamzin (1765–1826), critic and historian—'Poor Liza'; 'History of the Russian State'.
Basil Zhukofsky (1783–1852), critic and translator.
Alexander Griboyedof (1795–1829), dramatic poet—'The Misfortune of Being Clever'.
Alexander Pushkin (1799–1837), poet, dramatist, and short story writer—'The Prisoner of the Caucasus'; 'The Gypsies'; 'Boris Godunof'; 'Eugene Onegin'.
Alexis Koltsof (1808–1842), greatest Russian folk-poet, author of numerous songs and ballads.
Nikolai Gogol (1809–1852), realistic novelist and dramatist—'The Inspector-General'; 'Taras Bulba'; 'Dead Souls'.

Vissarion Belinsky (1811–1848), critic and essayist.
Mikhail Lermontof (1814–1841), lyric poet and novelist—'The Demon'; 'The Hero of Our Time'; 'The Angel'.
Alexei K. Tolstoy (1817–1875), novelist, dramatist, poet—'Prince Serebrany', historical romance; 'Death of Ivan the Terrible' and 'Tsar Feodor Ivanovich', dramas.
Ivan Turgenief (1818–1883), novelist—'A Sportsman's Sketches'; 'Fathers and Sons'; 'Virgin Soil'.
Feodor Dostoyefsky (1821–1881), psychological novelist—'Crime and Punishment'; 'The Brothers Karamazof'.
Alexander Ostrofsky (1823–1886), dramatist—'The Storm'; 'Poverty Not a Vice'.
Leo Tolstoy (1828–1910), novelist and philosopher—'War and Peace'; 'Anna Karenina'; 'Kreutzer Sonata'; 'The Death of Ivan Ilyich'; 'Master and Man'; 'Resurrection'.
Innocent Annensky (1856–1909), poet—'The Cypress Chest'.
Anton Chekhof (1860–1904), dramatist and short story writer—'The Darling'; 'The Duel' (*see* Drama list).
Feodor Sologub (Feodor Teternikof) (1863–1927), novelist and poet— 'The Little Demon', novel.
Maxim Gorky (Alexis Peshkof) (1868–1936), novelist and short story writer—'Comrades'; 'Lords of Life'; 'Humble Folk'; 'Mother'; 'The Bystander'; 'The Magnet'; 'My Childhood'; 'In the World'; 'Reminiscences of My Youth'.
Ivan A. Bunin (1870–), novelist, short story writer, and poet—'Gentleman from San Francisco'; 'The Village'.
Leonid Andréef (1871–1919), dramatist and short story writer—'The Red Laugh'; 'The Seven That Were Hanged'; 'Anathema'; 'Judas Iscariot'; 'The Crushed Flower'.
Alexis Remizof (1877–), novelist—'The Pond'; 'The Clock'; 'The Sisters of the Cross'; 'The Fifth Pestilence'.
Alexander Blok (1880–1921), poet—'The Scythians'; 'The Twelve'; 'The Earth under Snow'; 'Hours of the Night'.
Andrey Byely (Boris Bugaief) (1880–1934), poet and novelist—'The Silver Dove'; 'Moscow'; 'Petersburg'; 'The Urn'.
A. N. Tolstoy (1882–), novelist—'Peter the Great'; 'Bread'.
Demyan Byedny (1883–), journalistic poet—'The Workmen's Hymn'.
Feodor Gladkof (1883–), novelist—'Cement'.
Lydia Seifullina (1889–), short story writer and novelist—'Virineya'; 'Humus'.
Boris Pasternak (1890–), poet—'My Sister'; 'Life'.
Michael A. Bulgakov (1891–1940), novelist, playwright—'Days of the Turbins'; 'Molière'.
Ilya Erenburg (1891–), satirist—'The Adventures of Julio Jurenito'.
Constantine Fedin (1892–), novelist—'Cities and Years'.
Sergei Semenof (1893–), novelist—'Natalia Tarpova'.
Vladimir Mayakofsky (1894–1930), poet and dramatist—'The Cloud'; 'Left March'; 'Mysteria-Bouffe'; 'Lenin'.
Boris Pilnyak (1894–), short story writer and novelist—'The Naked Year'; 'Leather Jackets'; 'Machines and Wolves'.
Isaac Babel (1894–), short story writer—'Stories of the Red Cavalry'; 'Tales'.
Sergei Yessenin (1895–1925), poet—'Transfiguration'; 'Pugachef' and 'Stenka Razin', poetic dramas.
Vsevolod Ivanof (1896–), short story writer and novelist—'The Armored Train'; 'Colored Winds'.
Artem Vesely (1898–), novelist—'My Native Land'.
Leonid Leonof (1899–), novelist—'The Badgers'; 'Sot'.
Ilya Selvinsky (1899–), poet—'Pao Pao', lyrical play; 'Knight John', historical tragedy.
Mikhail Sholokhov (born 1905), novelist—'And Quiet Flows the Don'.

RUSSO-JAPANESE WAR (1904–1905). Before the World War of 1914–1918, this was considered one of the greatest military struggles of all times. It opened a new chapter in the history of the Far East, marking a new era in the national life of Japan and tremendously advancing her power. The British, who had feared Russia's pressure on India, saw that power go down like a card house before Japan, with whom England was allied.

Japan had been embittered at the close of her successful war against China, in 1895, by the demand of Russia, Germany, and France that she evacuate Port Arthur and the Liaotung Peninsula, ceded to her by defeated China. She yielded, but was deeply angered when three years later Russia seized this territory for herself. Japanese discontent was increased a few years later when Russia made the Boxer troubles in China an excuse for occupying Chinese Manchuria, under pretext of guarding her railroad and other interests there. Japan pressed Russia to keep her promises to withdraw from Manchuria, but Russia quibbled and evaded. A Russian concession for timber cutting in the Yalu Valley was protested against as the beginning of an attempt to bring Korea under Russian control. But Russia blindly blundered on toward the inevitable war, for which she was far from being prepared.

Japan struck deceptively in February 1904. Without a declaration of war, the Russian Far Eastern fleet at Port Arthur was torpedoed. The conflict was on, with Japan efficient and ready, and Russia weak because of the ignorance and corruption of many of her leaders. Port Arthur was besieged by the Japanese army under General Nogi and the fleet under Admiral Togo. Japanese armies swarmed into the peninsula and drove the Russians back in a series of disgraceful defeats. The chief disaster was at Mukden, in February 1905, when Oyama defeated Kuropatkin, Russia's greatest general. The Russian fleet from Europe was crushed in May as soon as it arrived, in the great battle of the Sea of Japan. The single-track line of the Trans-Siberian Railroad proved inadequate to bring up supplies and reinforcements. Russia was soon in utter collapse.

Finally President Theodore Roosevelt brought about a peace conference in Portsmouth, N.H. The resulting Treaty of Portsmouth (Sept. 5, 1905) gave Russia's rights in Port Arthur and the Liaotung Peninsula to Japan, and gave her also the southern half of the island of Sakhalin, which the Japanese call Karafuto. Russia agreed to evacuate Chinese Manchuria, and recognized Japan's paramount interest in Korea.

This Russian defeat contributed materially to the downfall of the czars 13 years later.

RUST. Rust is the red iron ash (iron oxide) which is formed when iron "burns" by uniting with the oxygen of water. Soil has varying amounts of this iron oxide. Red soil is "rusty" soil. Rust is slightly soluble in water, and in this form it is taken up and used by plants. Men and animals get the iron they need by eating the plants. It is iron that gives the color to the red corpuscles of our blood. John Ruskin said of iron: "It breathes the air, burns itself up in oxygen, and so gives its own life that we may live."

Neither wrought iron nor steel nor cast iron, as usually made, can be exposed to moist air without rusting. When a drop of rain falls on a clean bright surface of iron, for a short time the drop stays clear, showing the bright surface of the iron through it. But soon it takes on a greenish appearance, showing the compound formed by the oxygen in the water with the iron. Presently this compound turns reddish brown. This is rust. The rust does not stick to the iron, but is hung in the water, and becomes a coating only when the water has evaporated. Iron remains quite free from rust in an atmosphere containing water vapor, so long as the water vapor does not condense as liquid water on the surface of the iron. But when rust once forms, the iron will go on rusting in an atmosphere in which a piece of clean iron will not rust, because a rough surface aids condensing, and impurities hasten rusting. Thus it is much easier to prevent the first formation of rust than to stop the process. To prevent rust, oil paint is used, also a zinc coating (galvanizing) and japanning. Kerosene is useful in removing rust from metal.

RUSTS AND SMUTS. Minute parasite plants belonging to the group of fungi called *Basidiomycetes* prey upon our most valuable cereals and cause crop losses that total hundreds of millions of dollars every year. Not only do these diseases reduce the yield, but the harvested grain if smutted or rusted receives a lower grade in marketing or is rejected entirely. Wheat, oats, and barley are the crops chiefly affected, but rye, corn, beans, clover, a great many grasses, and some of the stone fruits also suffer seriously. In addition huge losses to the lumber industry are caused by a white-pine blister rust. Rusts and smuts are found practically the world over. So great is the economic injury done that national and state governments are investing vast sums in research into the causes, prevention, and cure, and in educating farmers to coöperate in warring against them.

Like mushrooms and other members of the big *fungi* family, "rusts" and "smuts" reproduce themselves by means of spores, tiny dustlike bodies, invisible except under a microscope (*see* Fungi). Black stem rust of wheat makes an interesting type study. It feeds at different stages on two different plants, which botanists term its "hosts." One host is the wheat plant, the other is the barberry shrub.

On the underside of the barberry leaf we find masses of orange-colored spores in little depressions called "cluster-cups." These spores, lighter even than dust particles, are easily carried by the wind for many miles. Falling upon the young wheat stalks, they lodge among the living cells and germinate, forming a threadlike mass called the "mycelium," corresponding to the spawn in mushroom culture. By appropriating the wheat's food, this filament flourishes while the useful plant is stunted.

When "Red" and "Black" Rusts Appear

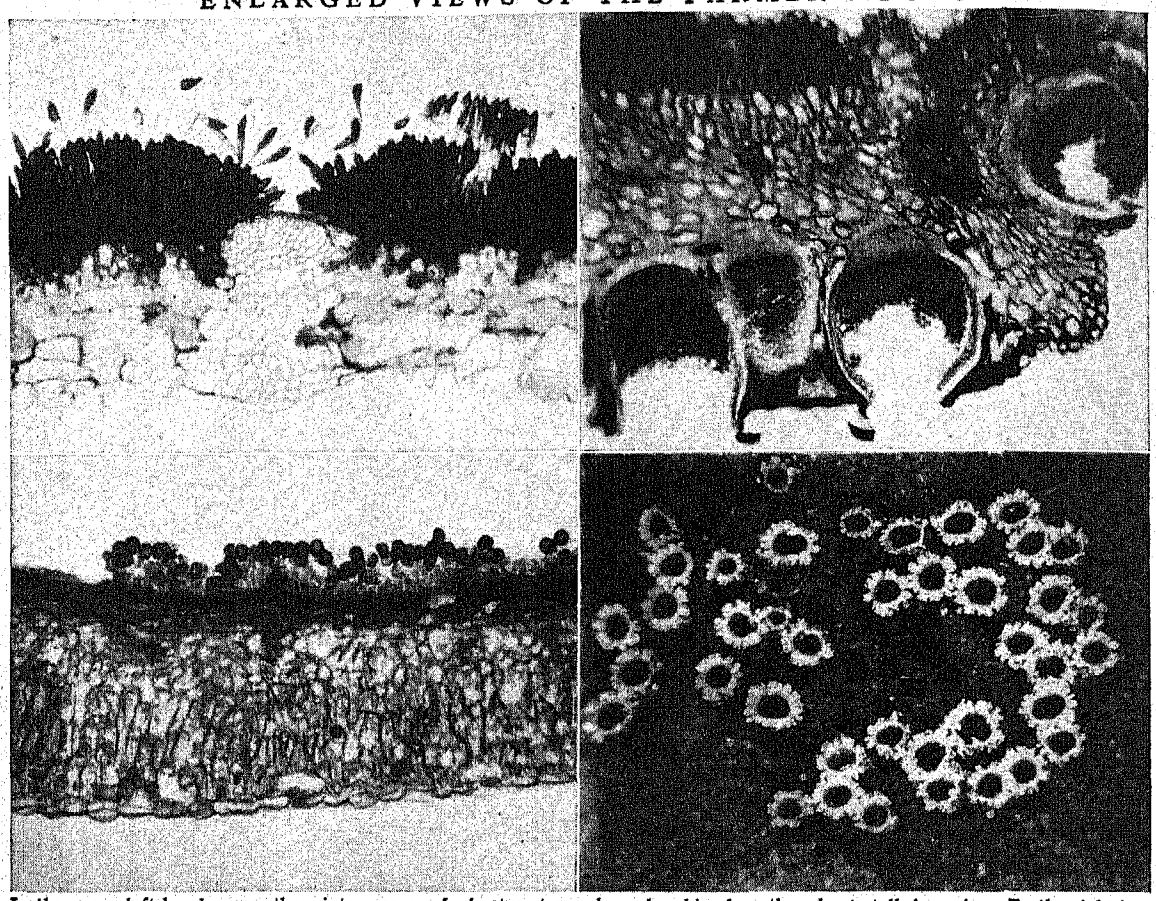
Before harvest time the crop of summer spores appears as rusty-looking lines or dots, usually upon the leaves but sometimes upon the stalk also. This is the "red rust" of wheat. Scattered by the wind upon nearby plants, these spores quickly germinate, spreading the disease with fearful rapidity during the growing season. Later in the summer "black rust" emerges upon the wheat stems as masses of dark-colored winter spores. These germinate the next spring, forming a filament that produces more spores for the wind to waft to the barberry leaves, ready to begin the deadly cycle all over again.

There are many kinds of rusts. One species alone, black stem rust, has more than 60 different forms which attack wheat, oats, barley, rye, and about 100 grasses, both wild and cultivated. Some species of rust have only one host, others have several. In the case of the white-pine blister rust, the secondary host may be either the currant or gooseberry bush, the eradication of which is urged to save our white pine forests.

FOUR RUSTS AND SMUTS AND THE GRAINS THEY RUIN

Here is the work of rusts and smuts upon wheat (1), barley (2), oats (3), and corn (4). To the left of the shriveled stalks of the first three is a fine healthy head of the same grain with plump well-developed kernels. The smutted ear of corn with its distorted kernels is almost as distressing a sight as a case of human disease.

ENLARGED VIEWS OF THE FARMER'S FOES

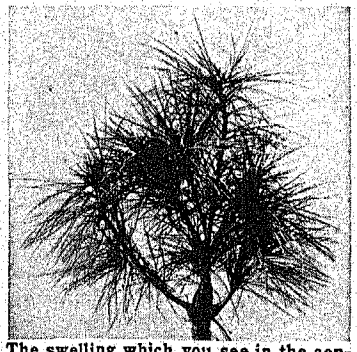


In the upper left-hand corner the winter spores of wheat rust are shown breaking from the wheat stalk in spring. To the right is a section of barberry leaf with "cluster cups" full of spores on the under side. In the lower left corner is a section of grass leaf which is furnishing pasture for a fine crop of one-celled summer spores of rust which can germinate on wheat without passing through the barberry stage. What looks like a group of daisies on the right is a daisy leaf on which are growing cluster cups of another species.

The smut fungus has a less complex history. In the case of smut of wheat, oats, and barley, the spores are clinging to the seed when sown. The fungus enters the plantlet soon after it sprouts, grows up with it, steals its food, and usually prevents it from forming seed. Instead, smeary smut masses form, consisting of millions of spores that in the threshing and handling attach themselves to the sound grains, thus endangering the next crop.

Corn smut is different in origin, being caused not by infected seed but by spores which have wintered either on the ground or in the manure used as fertilizer. When spring comes these spores produce others which the wind distributes over the cornfield, to penetrate the young corn plants. Large boil-like growths develop which gradually darken, forming "smut balls."

STILL ANOTHER RUST



The swelling which you see in the central stem of this young pine is due to white pine "blister rust," one of the worst enemies of the forest giants.

Smuts are spoken of as "loose," "covered," and "stinking" smuts. Loose smut changes the spikelet into a sooty mass which the wind blows away, leaving the stalk bare. Heads affected by covered smut remain on the stalk until the harvest. Stinking smut, or "bunt," affects only wheat kernels and is one of the most destructive wheat diseases, sometimes causing the loss of half the crop. The powdery mass inside the smutted grains smells like decaying fish.

For the prevention of grain rusts, experts are pinning their strongest hopes to the development of new varieties of grain able to resist the fungus. Important experiments in breeding and selection are in progress at agricultural stations all over the country. Hard red wheat has been found to offer good resistance. Early-maturing varieties escape the excessive rain and "muggy"

weather of late summer, conditions under which the rust plant thrives. Crop rotation helps to cure rust-infected soils. Excess of either nitrogen or moisture favors the infection. For many years "banish the barberry" has been the war-cry in grain-growing districts, and many states have now passed anti-barberry laws. Experiments prove that although the barberry stage is not always indispensable to wheat rust, it increases the distribution of the parasite.

Smuts lend themselves more readily than rusts to the preventive methods of modern agriculture. That is because the smut spores cling to the outside of the seeds and may be killed by disinfecting before sowing. For this purpose three treatments are in common use—by hot water, formaldehyde, and copper sulphate. Bulletins of the Department of Agriculture at Washington, which may be obtained free by writing for them, furnish complete and up-to-date information regarding materials, apparatus, and formulas. Disinfected seed needs, however, to be tested for germination before planting. Because of the peculiar character of corn smut, treating the seed is of no value. The only remedy is to burn the smutted stalks as they are discovered in the field. Fortunately this smut is of relatively small importance economically. Early seeding is strongly advised as a protection against smut as well as rust.

RUTH. In the days when the "Judges" ruled in the land of Israel—so the Bible tells us in the beautiful story of Ruth—a certain man of Bethlehem had gone with his wife Naomi and his two sons to dwell in the land of Moab. There he died and later the two sons, who had married Moabite women, also died. Sad and lonely, Naomi decided to return to her old home. So with her daughters-in-law, Ruth and Orphah, she started for Bethlehem.

Before they had gone very far, Naomi told her companions to return to their homes, for only grief and loneliness were in store for them if they followed her into a strange land. "Go, my daughters," she said, "return each to your mother's house, and may the Lord deal kindly with you as you have dealt with my sons and me." Then she kissed them, with many tears. And Orphah kissed her mother-in-law and went back, but Ruth clung to her and would not go back. "Entreat me not to leave thee," she said, "or to return from following after thee: for whither thou goest, I will go; and where thou lodgest, I will lodge: thy people shall be my people, and thy God my God: where thou diest, will I die, and there will I be buried: the Lord do so to me and more also, if aught but death part thee and me."

So Ruth and Naomi went on together, and they reached Bethlehem in the time of the barley harvest.

AND RUTH SAID, "ENTREAT ME NOT TO LEAVE THEE"

On the stony borders of the land of Moab, widowed Naomi pauses, and strong-hearted Ruth makes a momentous choice, saying "Whither thou goest, I will go; where thou lodgest, I will lodge." It was so that she met Boaz and became the mother of the race of David. This picture by Philip Calderon hangs in the Walker Art Gallery of Liverpool, England.

It was the custom in those days for the poor to go into the fields and pick up, or glean, the grain which the reapers had left behind. Ruth went out to glean, that she and Naomi might have food; and it so happened that she came to the field of a wealthy kinsman of her husband's, named Boaz. He noticed Ruth as she gleaned among the reapers, and he asked after her. And when they told him who she was, and how she had left her native land to come to a strange place, he was deeply moved by her loyalty to Naomi. He spoke kindly to Ruth, telling her to come again to his field. He commanded his young men to treat her with respect and told them to let some of the grain fall on purpose for her.

Ruth returned home very happy that evening and described the great kindness of Boaz. "The man is one of our near kinsmen," said Naomi. So day after day Ruth gleaned in the field of Boaz; and at the end of the harvest he "took Ruth and she was his wife." They were very happy together, and still more happy when a son was born to them. They called him Obed, and in after years Obed became the father of Jesse, the father of David, one of the great kings of Israel. The story may be read in the Book of Ruth in the Old Testament.

RYE. In the northern countries of Europe where wheat does not grow well, rye is the principal breadstuff, making the common "black bread" and "pumpernickel." Usually rye flour contains the whole substance of the grain, and therefore is richer in protein than white wheat flour.

Rye (*Secale cereale*) is a cereal grain closely related to wheat. There are fewer varieties than of any other important grain, and all may be classified as winter or spring types. Rye does not seem to have been cultivated by any of the peoples of antiquity. Its early home was in Europe, probably in the region lying north of the Black Sea. Rye is hardier than wheat, growing on poorer, lighter soils, in mountainous regions, and in cold northern countries, although it does not grow in the extreme north so well as barley. It is sometimes called "the grain of poverty" because of its adaptability to poor soils, but when grown on land good enough for wheat it will grow thick, stout, and seven feet tall. The world's production of rye is less than half that of wheat. Russia, Germany, and the Scandinavian countries are the chief producers. In the United States it is of minor importance compared with wheat or oats; only about one bushel of rye is grown to 10 bushels of wheat.

The rye plant is too strong and wiry to make good forage for cattle, though it is grown in the south of England for this purpose. Another objection to it as a forage crop is that it is subject to the attack of a highly poisonous fungus. The fungus (*Claviceps purpurea*) grows in place of the grains, and forms horny masses called "ergot." Ground rye and rye bran are used as stock feed. Rye straw is longer and more uniform in size than that of other grains, and is used in the manufacture of paper, pasteboard, and hats. It is also used for thatching roofs in parts of Europe, and for stuffing horse collars.

THE EASY REFERENCE FACT-INDEX

GUIDE TO ALL VOLUMES FOR SUBJECTS BEGINNING WITH

Q-R

TO SAVE TIME

USE THIS INDEX 

EDITOR'S NOTE ON NEXT PAGE TELLS WHY

INDEX

SPECIAL LISTS AND TABLES

Numerous other lists and tables in the fields of geography, history, literature, science, mathematics, and other departments of knowledge will be found with their appropriate articles in the main text

EDITOR'S NOTE

EVERY user of Compton's Pictured Encyclopedia should form the habit of *first* turning to the Fact-Index section at the end of each volume when in search of specific information. This index is a miniature work of reference in itself and will often give you directly the facts, dates, or definitions you seek. Even when you want full treatment of a subject, you will usually save time by finding in the index the exact page numbers for the desired material.

All page numbers are preceded by a letter of the alphabet, as A-23. The letter indicates the volume. If two or three page numbers are given for the topic you are seeking, the first indicates the more general and important treatment; the second and third point to additional information on other pages. Where necessary, subheadings follow the entry and tell you by guide words or phrases where the various aspects of the subject are treated.

The arrangement of subheadings is alphabetical, except in major historical and biographical entries. In these the chronological order is followed.

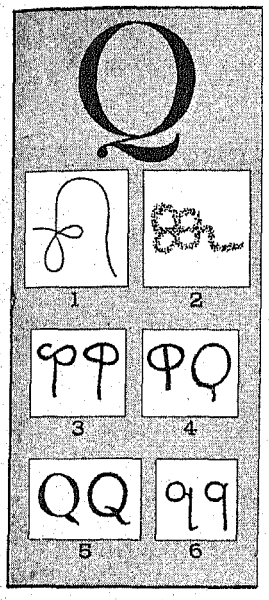
The pictures illustrating a specific subject as a rule appear on the same pages as the text to which you are referred. But often illustrations placed elsewhere will prove of additional interest and value. These are indicated by the word *picture* followed by a page number.

A picture reference is frequently intended to call attention to details in the text under the illustration as well as to the illustration itself. This picture-text, therefore, should always be carefully read.

The pronunciations given are those preferred by the best and most recent authorities; alternative pronunciations are indicated only where usage is equally divided. For foreign names the native pronunciation is given except where the English pronunciation has become thoroughly established, as in "Paris," "Barcelona," "Seine."

In recent years hundreds of foreign geographical names have been changed, either officially or by custom. Both old and new names are given at the appropriate places in the alphabet.

Populations are given in round numbers, except for places in the United States and Canada, where the figures are those of the latest official census. Distances between points are map or air distances, not distances by railroad.



AS NEARLY as anyone can tell, our letter Q started in Egyptian writing as some form of a looped rope, perhaps as a picture (1) which meant 'lasso'. Soon after 2000 B.C., a Semitic people called the Seirites adopted this sign as an alphabetic sign for a deep, throaty 'k', because their word *kaw* (pronounced somewhat like *qaow*) began with this sound.

They made the sign with several small loops (2). Later the Canaanite-Phoenician alphabet developed simplified forms (3). In all Semitic languages, the name of this sign resembled the Hebrew term *koph*.

When the Greeks learned how to write from the Phoenicians, they renamed the sign *koppa* and used it for several centuries (4). But to the Greeks the sound indicated by the sign *koppa* was exactly like the sound indicated by the Greek K, or *kappa;* so gradually the Greeks dropped *koppa* as useless. Before this happened, however, the Romans had learned to write from the Greeks, and they had acquired the early Greek habit of using *koppa* for a 'k' sound before *u*. They called the letter *koo* and eventually they gave it a round form with a curved tail (5). In this form the letter came from Latin into English; and English follows Latin in using 'q' for a 'k' sound before *u*.

Our small 'q' developed from the old Greek *koppa* between the 6th and the 9th centuries after Christ, with a shift of the circle from the top to the left (6).

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

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"Q-ships," in anti-submarine warfare S-314
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Quackgrass, a perennial grass (*Agropyron repens*), which in cultivated lands is a troublesome weed; sometimes used for sheep grazing; also called couch grass, quick grass, or quitch grass.
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Quaes'tors, officials of ancient Rome, who controlled the finances of military and other organizations
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Quai d'Orsay (*kĕ dôr-sĕ'*), the French foreign office, so named from the quay on the s. bank of the Seine in Paris where its buildings stand
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Quantz (*kvänts*), **Johann Joachim** (1697–1773), German flutist; teacher of Frederick the Great (then crown prince); became court composer when Frederick ascended throne; composed for the flute and improved its mechanism.
Quapaw (*kwô'pô*) **Indians.** *See in Index* Arkansas Indians
Qu'Appelle (*kà-pĕl'*) **River** (French, "Who calls?"), tributary of the Assiniboine in s. Saskatchewan, *map* C-50*b*
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"Quarantine aggressor nations," phrase summarizing speech delivered in Chicago on Oct. 5, 1937, by President Franklin D. Roosevelt; it marked the beginning of active American opposition to German-Italian-Japanese conquest policy.
Quarry, in hunting, the bird or animal hunted; the prey
in falconry F-7
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Quart, in dry and liquid measure, *table* W-67
Quarter-deck, on sailing vessels afterportion of the upper deck reserved for officers and sometimes for cabin passengers (originally the deck above the aftercastle, or cabin, ¼ length of deck); on modern war ships, any deck reserved for officers and for ceremonies.
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Quartermaster, U. S. Navy, petty officer who attends to the helm, binnacle, signals, etc.
insignia, *picture* U-179
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Quarter-sawed lumber, lumber made by first sawing a log lengthwise into quarters by cuts passing through center or heart of log; boards are then cut alternately from the two flat faces of each quarter
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Quasimodo (*kà-zĕ-mô'dō*), a dwarf, a chief figure in Victor Hugo's novel, 'Notre Dame de Paris'.
Quassia, a genus of the family *Simarubaceae* of chiefly tropical trees and shrubs. The bitter wood of *Quassia amara* is used for medicinal purposes. It is native to tropical America.
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Quatre-Bras (*kàt'rŭ brà*), village 19 mi. s.e. of Brussels; indecisive battle between British and Germans under Wellington and French under Ney, on June 16, 1815, 2 days before battle of Waterloo.

Quay, Matthew Stanley (1833–1904), U.S. senator from Pennsylvania, 1887–1904; for 35 years leader of Republican party in his state and from 1885 a member of the national committee
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Quebec (*kwē-bĕk'*), oldest and largest of provinces of Canada; 594,534 sq. mi.; pop. 2,874,255; cap. Quebec: Q-3–5, *map* C-50*c*
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Quebec, City of, capital of province of Quebec on St. Lawrence River; pop. 130,594: Q-6–7, *map* C-50*c*, *pictures* Q-6, 7, C-60
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Quebec Act, a measure passed by British Parliament 1774 extending province of Quebec to Ohio and Mississippi rivers, establishing French civil law in the province, and withholding representative institutions; provoked great resentment among English colonists and helped bring on Revolutionary War.

Quebracho (*kā-brä'chō*) (from early Spanish word for "ax-breaker"), any one of several hardwood trees with hard, dense wood that contains tannin. Quebracho blanco, or white quebracho (*Aspidosperma quebracho blanco*), of dogbane family, is a tall tree with a white wood used mainly for lumber. Quebracho colorado, or red quebracho (*Schinopsis lorentzii*), is the chief source of the tanning extract: S-207
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Queen, title given to a woman sovereign of a state; queen regnant, queen in her own right; queen consort, wife of a king; queen dowager, widow of a king; queen mother, mother of a king.

Queen Anne, Age of, in English literature E-285

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Queen Anne's War (1701–13), war between England and France over their colonies in North America, a part of the European War of the Spanish Succession: A-211, A-162, *chart* H-306
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Queen Charlotte Islands, part of British Columbia, Canada, 100 mi. off coast and 135 mi. above Vancouver Island; 5100 sq. mi.; coal and other minerals; pop. about 2000, mostly Indians; *map* C-50*b*

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Queen of Sheba S-192

Queen of the Antilles C-410

Queens, Borough of, part of New York City N-134, *map* N-130

Queensberry, John Sholto Douglas, 8th **Marquis of** (1844–1900), English statesman and sportsman; represented Scotland in Parliament, 1872–1880; noted as a patron of boxing; took part in formulating "Queensberry Rules" for boxing: B-208

Queensberry rules, for boxing B-208

Queensborough Bridge, New York City, *table* B-342

Queens College, at Charlotte, N.C.; founded 1857 by Presbyterian church; for women; arts and sciences.

Queen's College, Oxford O-260

Queen's County. *See in Index* Laoighis

Queensland, a state in n.e. Australia; 670,500 sq. mi.; pop. 950,000; cap. Brisbane: Q-7–8, *map* A-372*a*, *pictures* A-374*a*, M-31

Queensland nut. *See in Index* Macadamia

Queenston Heights, Battle of, a battle in War of 1812 at Queenston, Ontario, six mi. n. of Niagara Falls, when British, under General Brock, won victory over Americans.

Queenstown, now **Cobh,** seaport in s. Ireland; pop. 8000: C-290, *map* E-270*a*

Queen's University, Belfast, Northern Ireland, formed 1908 from Queen's College, which was founded 1849; arts and sciences and the professional schools; college of technology allied with it.

Queen's University, one of leading Canadian universities, at Kingston, Ontario; founded 1841 by Presbyterians but since 1912 non-sectarian; arts and science, theology, applied science, medicine.

Queensware, a Wedgwood pottery P-332

Queen wasp W-32–3, *pictures* W-33, 35

Quelimane, Mozambique. *See in Index* Quilimane

'Quem quaeritis', ceremonial chant of early Roman Catholic church which was dramatized in medieval times and developed into "liturgical drama" of the church; depicts incident of the Three Marys and the Angel at tomb of Jesus.

'Quen'tin Durward', novel by Scott S-51

Quequechan River, in Massachusetts F-7

Quercia (*kwĕr'chä*), **Jacopo della** (1371–1438), Italian sculptor S-58

Quercus (*kwĕr'kŭs*), the oak genus of trees.

Queres Indians. *See in Index* Keres

Querétaro (*kā-rā'tä-rō*) Mexico, state in center; 4432 sq. mi.; pop. 235,000; cap. Querétaro.

Querétaro, Mexico, capital of state of Querétaro, 110 mi. n.w. of Mexico City; pop. 33,000; cotton mills.

Quern, a hand-mill F-117

Quervain (*kĕr-vän'*), **Alfred de** (1879–1927), professor of meteorology at Zurich University, Switzerland; crossed Greenland in 1912–13
route of Greenland trip, *map* G-176

Quesnay (*kĕ-nĕ'*), **François** (1694–1774), French economist and founder of the school of physiocrats; became court physician in 1752. *See also in Index* Physiocrats

Question-answer, form of study S-310

Question mark P-368

'Quest of the Holy Grail', painting by Abbey, *pictures* A-315, 316

Quetelet (*kĕt-lĕ*), **Lambert Adolphe Jacques** (1796–1874), Belgian astronomer, mathematician, and statistician; director Royal Observatory; published works on statistical research, astronomy, meteorology
applies mathematics to biology B-118

Quet'ta, India, fortified frontier town, cap. of British Baluchistan, at end of Bolan Pass; terminus of railroad; British army post; devastated by earthquake in 1935; pop. 49,000 (including cantonment): *map* I-30

Quetzal (*kĕt-säl'*), bright green-crested bird Q-8
on flag F-95, *color plate* F-88
Quezaltenango named for G-181*b*

Quetzal, the monetary unit of Guatemala, nominally worth about $1.00; coined in denominations of 5, 10, and 20 quetzales.

Quetzalcoatl (*kĕt-säl-kwät'l*), a hero-god of the Aztecs, Toltecs, and Mayans: M-142*b*, *d*, *picture* M-142*c*

Queues (*kūz*), or **pigtails**
China C-216, *picture* C-217
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Quevedo y Villegas, Francisco Gómez de (*kā-vā'dō ē vē-yĕ'gäs*) (1580–1645), Spanish writer, active in politics and diplomacy until imprisoned by Philip IV; wrote poetry, satire and picaresque novel ('Historia de la vida del Buscón').

Quezaltenango (*kā-säl-tĕ-nän'gō*), 2d largest city in Guatemala; industrial center for highlands; shoes, brooms, wool, flour; pop. 30,000: G-181*a–b*, 181*d*

Quezón (*kā-sōn'*), **Manuel** (born 1878), Philippine politician, leader in movement for independence; president Philippine senate almost continuously 1916–35
president commonwealth P-170: inauguration, *picture* P-165

Quiberon (*kē-bē-rôn'*), France, historic town on Bay of Quiberon on peninsula 22 mi. s.e. of Lorient; defeat of French Royalists by Republicans (1795).

Quiberon Bay, small arm of Bay of Biscay e. of Quiberon; here British navy under Admiral Hawke defeated French under Conflans on Nov. 20, 1759 (Seven Years' War).

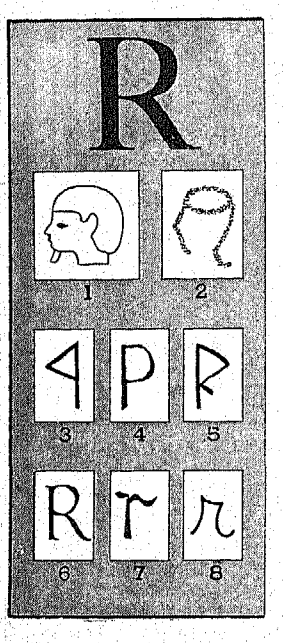
Quiché (*kē-chā'*), department in s.w. Guatemala, cap. Quiché; also name of an ancient Indian nation of Mayan stock; history traced to 8th century; descendants still found in highlands of Guatemala.

Quichuas (*kē'chǫ-äs*), a family of South American native tribes in Peru, Ecuador, and Bolivia; formed greater part of ancient Inca Empire. *See in Index* Incas

Quick, Herbert (1861–1925), American novelist, born Grundy County, Ia.; taught school; practised law; edited *La Follette's Weekly, Farm and Fireside,* wrote on opening of Middle West ('Vandemark's Folly'; 'The Hawkeye'; 'One Man's Life', autobiography).

Quick grass. *See in Index* Quackgrass

Quicklime, unslaked lime, or **calcium**



OUR LETTER R probably started in Egyptian writing as a finely done little picture (1) which meant 'head'. Soon after 2000 B.C., it acquired a new meaning when a Semitic people called the Seirites adopted it as an alphabetic sign for the sound of 'r'. They did so because their name *resh* for 'head' began with this sound.

The Seirites imitated the Egyptian sign crudely (2). The Canaanite-Phoenician alphabet simplified the sign and straightened the curves. The resulting triangle pointed left, because this was convenient for writing in Semitic fashion from right to left (3). All Semitic names for this sign resembled the Hebrew name *resh*.

When the Greeks learned how to write from the Phoenicians, they took over the *resh* sign, but they turned it around for greater ease in writing from left to right. They also renamed it *rho* and sometimes gave it a graceful curve (4). Other forms had a slight tail (5).

The Romans took this sign into Latin. But their sign for P came to look almost the same, so they gave the Greek *rho* a pronounced tail (6). In that form the letter came into English.

The small handwritten 'r' got a start in Greek as a rounded form of the capital. In medieval times the curved stroke was made toward the right to connect with the next letter (7). This form came into English and was simplified into our present handwritten form (8). The printed small 'r' omits the right-hand down stroke of the handwritten one.

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

'R-34', an airship, B-26, *picture* B-31
Ra, Egyptian deity. *See in Index* Re
Raab (*räb*), Hungary. *See in Index* Győr
Raabe (*rä'bŭ*), **Wilhelm** (1831–1910), German novelist; eccentric characters ('Cristoph Pechlin'; 'Horacker').
Rabat (*rȧ-bät'*), a fortified seaport in Morocco; seat of government in French zone and one of sultan's capitals; Hassan Tower, a splendid minaret of an old mosque is located here; pop. 84,000: *maps* A-127, A-42*a*
Rabaul (*rä'boul*), New Guinea, until 1941 capital of Mandated Territory of New Guinea, on n.e. coast of New Britain island; pop. about 2000: *map* P-10*b*
Rabbi (*răb'ī*), official title of Jewish ministers; a Hebrew word meaning "my master," originally applied to scholars and teachers of the law; used in New Testament as a title of respect in addressing Christ.
Rabbit R-9, H-221–3. *See also in Index* Hare
Australian plague A-375
coloration, protective H-222
cotton-tail H-222
distinguished from hare R-9, P-154, H-221
domestic breeds H-223, P-154
fur H-222
marsh H-223
nest, *picture* N-37
pets, care of P-154–5, *picture* P-155*a*
speed due to leg structure H-221
swamp H-223
tracks H-221
trap for T-128–9
Rabbit fever. *See in Index* Tularemia
Rabelais (*rä-be-lā'*), **François** (1493?–1553), celebrated French satirist and humorist R-9
influence on French language F-196
Rabies. *See in Index* Hydrophobia
Rabiru'bia, or **yellow-tail**, excellent salt-water food fish, belonging to the snapper family found in southern waters.
Raccoon (*ră'kọn'*), or **coon** R-9, *pictures* 9*a*
Raccoon Mountains, in n.e. Alabama; flat-topped ridge of s. Appalachians; 1800 ft.
Race, Cape, extreme s.e. point of Newfoundland; its lighthouse is an important beacon for ships crossing between Europe and North America: *map* C-50*c*
Raceme (*rȧ-sēm'*), a type of flower cluster F-121
Racemic acid, an optically inactive variety of tartaric acid T-14
crystals, *picture* C-409
Racer snakes S-172
Races of mankind R-9*b*–11, *Outline* R-11–12. *See also* Indo-European peoples, and other races by name
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prehistoric races M-45–8
skull measurements, classification by R-10
sociological study S-184
vital statistics P-304*d*
Ra'chel, favorite wife of Jacob, mother of Joseph and Benjamin.
Rachel, stage name of Elizabeth Rachel Félix (1821–58), French tragic actress; unequaled in such rôles as Racine's 'Phèdre'.
Rachmaninoff (*răk-män'ĭn-ôf*), **Sergei V.** (1873–1943), Russian pianist, also orchestral conductor and composer of distinction; important compositions include symphonies, a symphonic poem 'The Isle of Death', three operas ('Aleko', 'The Miserly Knight', and 'Francesca da Rimini') the famous 'Prelude in C Sharp Minor', 'Rhapsody on a Theme of Paganini', and numerous other works for piano; first American tour 1909; came to U. S. to live in 1918, after Russian Revolution; became citizen Feb. 1943.
Racial psychology P-361
Racine (*rȧ-sēn'*), **Jean Baptiste** (1639–99), French dramatist R-12
Racine, Wis., industrial city and port on Lake Michigan 50 mi. n. of Chicago; pop. 67,195: W-125, *map* W-124
Rack, apparatus of torture which dislocated joints of victims; rectangular wooden frame with rollers at each end to which the arms and legs were fastened; used by Spanish Inquisition and in England from 15th to 17th century.
Racket, tennis T-49, *pictures* T-51
Rackham, Arthur (1867–1939), English illustrator and water-color painter; distinguished for his highly imaginative and fantastic illustrations for fairy tales, legends, and folk tales ('Peter Pan'; 'Alice in Wonderland'; Hawthorne's 'Wonder Book')
estimate of Caldecott L-107
Raclawice (*räts-lä-vēt'sŭ*), **battle of**, fought at village of Raclawice n. of Cracow 1794; Russians defeated by Poles under Kosciusko: K-40
Radar, detecting and range-finding system based on reflected radio waves R-24–5
Radcliffe College, at Cambridge, Mass.; for women; organized 1879; non-sectarian; arts and sciences; graduate school; affiliated with Harvard.
Radetzki (*rä-dĕts'kē*), **Josef Wenzel, Count** (1766–1858), Austrian field marshal, conspicuous at Wagram and Leipzig against Napoleon; crushed Italian uprising 1848–49; idolized by his armies as Father Radetzki: F-186

RAILROAD MILEAGE FOR VARIOUS COUNTRIES

Algeria	3,000	Japan (proper)	14,500
Argentina	25,000	Latvia	2,100
Australia	27,000	Manchukuo	5,200
Belgium	3,200	Mexico	14,500
Bolivia	1,400	Netherlands	2,300
Brazil	20,000	New Zealand	3,500
Bulgaria	1,800	Norway	2,400
Canada	42,200	Persia	1,000
Chile	5,600	Peru	3,000
China	6,300	Philippine Islands	1,000
Colombia	2,000	Poland	13,300
Cuba	3,000	Portugal	2,100
Denmark	3,200	Rumania	7,000
Egypt	3,300	Spain	10,100
Esthonia	1,000	Sweden	10,500
Finland	3,500	Switzerland	3,600
France	40,000	Thailand	2,000
Germany	36,200	Turkey (Europe and Asia)	4,000
Great Britain	20,300	Union of South Africa	16,000
Honduras	1,000	U.S.S.R. (Russia)	50,700
Hungary	4,700	United States (including Alaska)	245,000
India, British	41,000	Uruguay	2,000
Indo-China, French	2,000	Venezuela	700
Ireland	3,000	Yugoslavia	6,900
Italy	11,300		

Ragtime, in music M-316

Ragusa (*rä-gōō'zä*), Yugoslavia, modern **Dubrovnik,** Adriatic port of Dalmatia; a medieval center of commerce and culture; independent state from downfall of Hungary, 1526 to 1815: A-382, *map* B-18

Ragweed, or **hogweed,** a common weed of North America of the genus *Ambrosia;* grows 1 to 7 ft. high, with small green flowers; an annual; its pollen is one of the chief causes of hay fever: W-64

Rahl, Johan Gottlieb (1720–76), Hessian soldier, born Hesse-Cassel; hired by George III to fight for British in American revolution; fought as colonel in battles of White Plains and Fort Washington; killed in battle of Trenton.

Rah'way, N. J., residential city on Rahway River 15 mi. s.w. of New York City; pop. 17,498; chemical works, printing houses, oil and cereal factories; scene of battle of Spanktown in Revolutionary War.

Raikes, Robert (1735–1811), English philanthropist, founder of first Sunday school: S-329

Rail, a water bird R-35
coot distinguished from C-356

Rail, railroad. *See in Index* Railroad, *subhead* rails

Rail-bus R-42

Railplane, *picture* T-126

Railroad R-36–46, T-125–6. *See also in Index* names of countries, *subhead* railroads, or transportation
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Alps S-353, *picture* S-356
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Lucin cut-off, in Utah G-150*a*, *picture* U-265
Transandine railroad A-195, C-207*c*, S-27, S-206*e*
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Interstate Commerce Commission I-110*f;* powers increased R-151
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importance in U.S. history R-37–8
locomotives L-177–8. *See also in Index* Locomotive
mail cars P-318, *pictures* P-319, 321
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sleeping cars R-39
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ties: creosote treatment C-394; cypress used for C-420; laid by machine, *picture* R-41
tracks, building and upkeep R-38, 39, *picture* R-41
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Asia: Trans-Siberian R-37, S-138; Turkestan-Siberian R-194
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trusts and rebating T-146
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western expansion, U.S. T-125–6, H-291

Railway, elevated. *See in Index* Elevated railway

Railway, street S-306–8. *See also in Index* Street railway

Railway brotherhoods, labor organizations among American railway employees; the "Big Four," with dates of organization, are the Brotherhood of Locomotive Engineers (1863); the Order of Railroad Conductors (1868); the Brotherhood of Locomotive Firemen and Enginemen (1873); the Brotherhood of Railway Trainmen (1883); maintain coöperative stores, mutual benefit funds, etc.

Railway Labor Act of 1926, amended 1934, first federal guarantee of right of employees (railway workers) to join trade unions; stipulated that agreements between unions and employers must be in writing; established National Mediation Board which reduced labor disputes in the railway industry.

Railway Mail Service, U.S. P-318, 322, *pictures* P-319, 321

Raimon Lull. *See in Index* Lully, Raymond

Rainbow R-46
Iris, goddess of I-130
Newton's explanation S-241

Rainbow Bridge, national monument in Utah N-22*d*

Rainbow trout T-145

Rain-crow, American cuckoo C-413

Raindrop
shape explained P-193

Rainey Sanctuary, for birds, in Louisiana B-146

Rainfall R-46–8
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agriculture in relation to R-46, 47, D-113*a*, *map* D-113*d*
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Borneo B-196
climate in relation to C-270*b*–71, R-46–8
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distribution around the world R-46–8, *map* R-47
Egypt E-194
erosion C-341–2, *picture* C-343
Europe, *map* E-318*a*

gum; important hardwood lumber source; common name also of *Eucalyptus rostrata*, a native of Australia: G-188

Red haw, the fruit of the hawthorn H-248

Redhead, a sea duck D-118

Red-headed woodpecker W-135, *picture* W-134

Red hel'leri, a fish, *color plate* A-233*a–b*

Red hind. *See in Index* Grouper

Redhorse, a large group of suckers with red fins abundant in northern United States and Canada.

Red-hot-poker plant. *See in Index* Kniphofia

Red International of Labor Unions L-45

Rediscount, in banking, the selling of a discounted, or accepted, note in order to secure credit F-21

Red Jacket (1750?–1830), last great chief of Seneca Indians; served with British in Revolutionary War, with U.S. in War of 1812.

Redlands, Calif., city in s. of state 65 mi. e. of Los Angeles in fruit-growing section; pop. 14,324; one of largest orange shipping centers of world; also ships lemons, grapefruit, and olive oil; University of Redlands: *map* C-28

Redlands, University of, at Redlands, Calif.; Baptist institution founded 1907; arts and sciences, education, music.

Red lead, or minium (Pb_3O_4), a red solid formed by heating lead oxide at 400° C. for some time; used on iron structures to prevent rusting.

Red letter days, originally the chief festival days of the Church which were indicated on the Church calendar by red letters; an exceptionally happy or lucky day in one's life.

Red lynx, or **bay lynx** L-223

Red macaw, *color plate* P-83–4

Red maple, scarlet, or **swamp maple** M-56

Red Men, Improved Order of, a fraternal benevolent society organized in 1833 at Baltimore, Md., which through its ritual seeks to preserve the manners, customs and traditions of North American Indians. Its motto is "Freedom, Friendship, and Charity." The Degree of Pocahontas provides for membership of women.

Redmond, John Edward (1851–1918), Irish parliamentary leader, member British House of Commons 1881 to his death; friend and lieutenant of Parnell, whom he succeeded as leader of Irish members; as leader of reunited Irish nationalists after 1900 sought Home Rule by persistent but peaceable methods.

Red Mountain, in Alabama B-146
iron ore A-98*b*

Red mulberry M-298

Red oak, a name applied to the group of oaks with brown wood which has a red tint and is more subject to decay than white oak. Includes the species northern red, southern red, swamp red, scarlet, black, blackjack, laurel, pin, shumard, water, and willow oaks: O-189, 190, *pictures* T-132, 134
leaf *picture* T-135

Redon (*rŭ-dôn'*), **Odilon** (1840–1916), French painter, etcher, and lithographer; works are marked by imagination, keen vision, and mysticism; especially noted for his exquisite floral paintings.

Redondo Beach, Calif., city on the Pacific, 16 mi. s. w. of Los Angeles; pop. 13,092; lumber, oil fields, fishing, amusement concessions.

Redoubt, a field fortification, to help an advance post defend a hilltop or other dangerous position.

Red pepper P-119, *picture* S-251

Red phosphorus P-177

Red pine P-220, 221

Redpoll. *See in Index* Linnet

Red Polled cattle, a beef breed C-105

Red race, or American race R-10, *Outline* R-12

Red raspberry R-51

Red Riding Hood, Little, character in children's tale of same name; in original French version by Charles Perrault, she was eaten by a wolf disguised as her grandmother; in German and other variants, she was saved by a woodsman.

Red River, southernmost of great tributaries of the Mississippi; rises in Staked Plains of Texas; 1275 mi. long: *maps* T-56, L-206, O-216

Red River, sometimes called **Red River of the North,** rising in Minnesota and flowing 700 mi. n. to Lake Winnipeg: R-62, *map* M-192
in North Dakota N-161, 162

Red River Rebellion R-62, M-54–5
Strathcona S-305

Red River Settlement, colony established near present city of Winnipeg in 1812 by Lord Selkirk, member of Hudson's Bay Company.

Red root. *See in Index* New Jersey tea

Redruth, England, town in Cornwall; pop. 10,000; tin mining; home of William Murdock, *picture* G-23

Red scale insect S-35

Red Sea, arm of Indian Ocean between Arabia and Africa connected with Mediterranean by Suez Canal; 1200 mi. long: R-62, *maps* B-8, A-332*a*, *b–c*. *See also in Index* Ocean, *table*
color, origin P-236
shoreline, *picture* A-237
Suez Canal S-317–18

Red-shouldered hawk H-246, B-288, *pictures* H-246

Red snow, cause of P-236, S-174

Red sorrel. *See in Index* Roselle

Red-spotted damsel-fly D-90

Red spruce, a tree S-264

Red Square, in Moscow M-264, *picture* M-263

Red squirrel, or **chickaree** S-266
hibernation H-288

Redstart, a warbler W-7

Red Sulphur Springs, W. Va. W-74

Red-tailed hawk H-246, B-288

Red-throated loon L-196

Redtop grass. *See in Index* Bentgrass

Reductio ad absurdum, a method of proof in geometry G-51

Reduction, in chemistry C-171, *picture* C-173

Reduction division, or **meiosis,** in biology, a type of cell division, *pictograph* H-283*b*

Red viper, red adder, copperhead, or **copper-belly** C-361, *picture* S-170
a pit viper V-302–3

Red waterbuck, *picture* A-219

Red Wing, Minn., town on Mississippi River, 40 mi. s. e. of St. Paul; pop. 9962; named for an Indian chief; missionary post here in 1836; pottery, clay pipe, marine motors, shoes: *map* M-192

Redwinged blackbird B-152, *color plate* B-137
scientific name B-153

Redwood, a sequoia S-79–80
lumber S-80; cutting L-218

Redwood City, Calif., 23 mi. s.e. of San Francisco; pop. 12,453; cut flower industry; cement, leather, lumber.

Ree. *See in Index* Arikara

Reed, Ezekiel (18th century), American inventor of first nail-making machine N-2

Reed, James A. (born 1861), American political leader and lawyer; born near Mansfield, Ohio; prosecuting attorney of Jackson County, Mo. 1898–1900; mayor of Kansas City, 1900–04; U. S. senator from Missouri, 1911–29, opposed League of Nations.

Reed, Stanley Forman (born 1884), jurist, born Mason Co., Ky.; general counsel Reconstruction Finance Corp. 1932–35; solicitor general of U. S. 1935–38; appointed associate justice U. S. Supreme Court 1938, by President F. D. Roosevelt.

Reed, Thomas B. (1839–1902), American statesman, born Portland, Me., congressman from Maine 1876–99, Republican leader and speaker of House 1889–91 and 1895–99; called "Czar" Reed because of his stringent rulings (continued as permanent rules of procedure) to increase efficiency of House; able parliamentarian and witty public speaker.

Reed, Walter (1851–1902), American army surgeon and bacteriologist, born in Gloucester County, Va.; established laboratory for instruction in bacteriology for army medical officers; researches in malaria and typhoid during Spanish-American War contributed greatly to knowledge of those diseases: P-46
yellow fever discoveries M-270

Reedbird, name often used for bobolink in middle United States.

Reedbuck, a South African antelope, so called because it frequents reedy places near water.

Reed College, at Portland, Ore.; founded 1911; arts and sciences.

Reed furniture F-222

Reed organ, harmonium, or **cabinet organ** O-250, *picture* M-322

Reeds, a group of musical instruments M-323, W-135

Reeds, various tall hollow-stemmed grasses G-136*j*
dwellings made of S-110, 111
pens P-103, *picture* P-104
swamp societies W-49

Reef points, of a sail B-164

Reefs, coral C-362–4
atolls of Pacific P-5
Florida Keys K-15
Great Barrier C-364, *picture* C-363, *map* A-372*a*, *b*
Red Sea R-62

Reelfoot Lake, lake 18 miles long in n.w. Tennessee, extending slightly into Kentucky; hunting and fishing; state property: *map* T-46
formed by earthquake E-136

Reel oven B-230

Reese, Lizette Woodworth (1856–1935), American poet, born Baltimore County, Md. ('A Branch of May'; 'A Quiet Road'; 'A Victorian Village', autobiography).

Reeve, Arthur Benjamin (1880–1936), American writer of popular detective stories, born Patchogue, N. Y. ('Adventures of Craig Kennedy'; 'Exploits of Elaine'; 'Pandora').

Reeve, a bird. *See in Index* Ruff

Reeve, in English history, an administrative officer D-46

Refectory, in monasteries M-233–4

Referee, in court decisions J-231

Referee, in football F-151

Messina; pop. 120,000; silk, perfume, olive oil; earthquakes 1783, 1908; ancient Greek city Regium
mirages M-199

Reggio nell' Emilia (*nĕl lā-mēl'yä*), commercial and manufacturing city in n. Italy 90 mi. n.e. of Genoa on branch of Po River; pop. 90,000; cathedral, works of art.

Regicides (*rĕj'i-sīdz*), in English history, those persons directly responsible for execution of Charles I; especially the 67 members of High Court of Justice who voted for the death penalty; they were later proscribed
Judges' Cave at New Haven N-88

Regillus (*rē-jĭl'ŭs*), ancient lake near Rome, now disappeared
battle of R-130: festival on anniversary, *picture* R-141

Reg'iment, in U.S. Army A-307*b*, *e*

Regin (*rē'yin* or *rā'gĭn*), in Norse and German mythology S-140–1

Regina (*rē-jī'nà*), capital of Saskatchewan; pop. 53,354; railroad and trade center: R-70, *map* C-50*b*

Regional planning. *See also in Index*
City planning
land use L-61*c*
recreation and amusements L-93*d*

Regis College, at Weston, Mass.; Roman Catholic institution for women, founded 1927; arts and sciences.

Registered mail P-318

Registered stocks and bonds S-291

Registrar, of college U-258

Regium, ancient Greek city in Italy, now Reggio Calabria.

Régnier (*rān-yā'*), **Henri François Joseph de** (1864–1936), French poet and novelist; beautiful, highly perfected style; member of French Academy; F-198
chief works F-199

Regression, in reading R-56

Regression, law of, in heredity B-118

Regular Army A-307*c–d*

Regular clergy C-232, M-234

Regular verbs V-282

Regulators, in North Carolina N-159

Regulus (*rĕg'yų-lŭs*), **Marcus Atilius** (3d century B.C.), Roman general and consul in first Punic War; captured by Carthaginians and executed.

Regulus, a bright star S-274, *charts* S-275*c*, *g*
right ascension S-275*a*

Re'han, Ada (1860–1916), American actress, born Limerick, Ireland; as leading lady for Augustin Daly and later as star won recognition both in high comedy and farce (Rosalind in 'As You Like It').

Rehobo'am (953?–937? B.C.), king of Israel, son of Solomon J-216

Rei (*rā'ē*) (plural, **reis**), a basis of coinage in Brazil under former system based on milreis; 50 reis, the smallest coin, worth about 1.2 cents in U.S. money when Brazilian currency is at par.

Reich (*rīĸ*), **Ferdinand** (1799–1882), German physicist and metallurgist; discoverer, with H. T. Richter, of indium.

Reich, German noun meaning government, state, empire; genitive form *Reichs* used in many compound words, as Reichskanzler, chancellor of the state, etc.

Reichenau (*rīĸ'ĕn-ou*), **Walter von** (1884–1942), German general; on general staff in 1st World War; in 1940 headed drive in Belgium and n. France, later fought in Russia.

Reichenbach (*rī'ĸĕn-bäĸ*), town in e. Germany 30 mi. s.w. of Breslau; pop. 31,000; Prussian victory over Austrians 1762; place of convention 1790 guaranteeing integrity of Turkey; alliance against Napoleon 1813.

Reichsbank, agency through which financial regulations and coinage laws of German government are carried out; created 1875; law of June 1939 gave Fuehrer Hitler complete control of its policies.

Reichsmark (*rīĸs'märk*). *See in Index* Mark

Reichspfennig (*rīĸs'pfĕn-ig*). *See in Index* Pfennig

Reichsrat (*rīĸs'rät*), a state council in the legislative system of Germany made up of elected representatives from each state; established 1919; in 1934 legislative powers taken over by Reich cabinet.

Reichstadt (*rīĸ'shtät*), **Duke of,** title given by his grandfather, Emperor Francis I of Austria, to Napoleon II (1811–32), son of Napoleon and Marie Louise; called L'Aiglon ("little eagle"); body sent to Paris by Adolf Hitler in 1940 to rest in Napoleon's tomb: N-10

Reichstag (*rīĸs'täĸ*) (German, "empire day"), in medieval times a meeting of emperor and vassals; evolved into German imperial diet; name given in 1871 to national parliament of Germany and retained as name of chief legislative body after fall of Empire in 1918; members (one for every 60,000 voters) are elected for 4 years; under Nazis made advisory body during Empire G-73

Reid (*rēd*), **George Agnew** (born 1860), Canadian painter, born Wingham, Ontario; known for genre, figure, landscape, and mural paintings; series of paintings in municipal buildings, Toronto; principal of Ontario College of Art, Toronto, 1912–1929
Indians watching the approach of Columbus, *picture* A-141

Reid, Ogden Mills (born 1882), American newspaper man, born New York, son of Whitelaw Reid; became editor of New York *Tribune* (*Herald Tribune*) 1913.

Reid, Robert (1862–1929), American painter, born Stockbridge, Mass.; influenced by impressionists; well known as mural painter (works in Library of Congress, Washington, D. C.; Massachusetts State House, Boston; Appellate Court House, New York City); easel paintings are landscapes and figures.

Reid, Samuel Chester (1783–1861), American naval officer, born Norwich, Conn.; commanded privateer *General Armstrong* in War of 1812; in repulsing a British attack at Fayal, 1814, he detained British ships on their way to New Orleans, thereby enabling Jackson to make adequate preparations to save the city; designed present U. S. flag, with 13 stripes and the addition of a star for each new state.

Reid, Thomas (1710–96), Scottish philosopher and psychologist, who taught that common sense is enough to explain certain fundamental beliefs, such as the existence of material world; claimed that man has instinctive knowledge of first principles; foremost of the Scottish school of philosophers.

Reid, (Thomas) Mayne (1818–83), Irish writer of tales of adventure and hunting romances; lived in U.S. 1840–49, traded with Indians, fought in Mexican War ('Scalp Hunters'; 'White Chief'; 'The Rifle Rangers'; 'The Boy Tar'; 'Afloat in the Forest').

Reid, Whitelaw (1837–1912), American journalist and diplomat, born at Xenia, Ohio; war correspondent and story writer under pseudonym "Agate"; after 1872 editor and principal owner of New York *Tribune*, succeeding Horace Greeley; Republican nominee for vice-president 1892; ambassador to France (1889–92) and to Great Britain (1905–12), where he became popular social figure as well as respected diplomat.

Reidsville, N. C., industrial city in n. w. of state; pop. 10,387; American Tobacco Co. plant here is known as "home of Lucky Strike cigarettes"; textile mills: *map* N-156

Reign of Terror, in French history F-204
Danton D-13
executions: Lavoisier F-45; Louis XVI L-203; Marie Antoinette M-64; Madame Roland R-127
Jacobins dominate J-181
Marat M-59–60
Robespierre R-117
Rochambeau opposed to R-120

Reikjavik. *See in Index* Reykjavik

Reims (*rēmz*, French *răṅs*), or **Rheims,** France, city in n.e. France 100 mi. from Paris; pop. 115,000: R-70–1, *maps* F-179, W-158
cathedral R-70–1, *picture* C-100: architecture A-269; sculptures S-54–6
coronation of Charles VII, *picture* C-151

Reincarna'tion, or transmigration of the soul H-293, B-259, P-374

Reindeer R-71, C-84, *picture* R-71
Alaska A-100, 106, *picture* A-106
Arctic regions A-278
Lapland L-64, *picture* T-123
length of life, average, *pictograph* A-198
prehistoric, *picture* C-119
Russia, *picture* R-179
Siberia A-325

Reindeer Lake, in n.e. Saskatchewan, Canada; 2437 sq. mi.: *map* C-50*b*

Reindeer moss, a lichen most abundant in arctic and subarctic regions; large starch content: L-122

Reinecke Fuchs, German for **Reynard the Fox,** character in old beast-epic F-166, S-303*i*, *picture* S-303*j*

Reiner, Fritz (born 1888), Hungarian musical conductor; conductor, Budapest, Dresden, Cincinnati, Pittsburgh; head, orchestra department, Curtis Institute of Music, Philadelphia; composed for string quartet and for voice.

Reinforced concrete B-264–5, *picture* B-267
bridge construction B-240

Reinhardt (*rīn'härt*), **Max** (1873–1943), Austrian theatrical director, producer of pantomime 'Sumurun', spectacle play 'The Miracle', Wilde's 'Salome', Shakespeare's 'Midsummer Night's Dream' (also in motion pictures), and many other plays; an innovator in use of simple settings, symbolizing an emotion or a scene; often used elaborate machinery, especially lighting devices, to create illusion of simplicity and of bringing audience into the action of the play; removed to U.S. 1935
settings T-77, D-97

Reis, Philipp (1834–74), German inventor of early telephone T-34

Reisch (*rīsh*), **Gregory de** (died 1525), German prior; wrote a small popular encyclopedia 'Margarita Philosophica': *picture* E-165

cessful in detective and mystery stories ('The Circular Staircase'; 'The Door'); also 'Bab'; 'Tish'; and autobiography 'My Story'.

Ring, a piece of jewelry, *color plate* G-27*a–b*
ancient Roman G-25
Indian nose-ring, *picture* G-27
wedding, meaning of M-69

'Ring and the Book', poem by Browning B-252

'Ring des Nibelungen, Der' (*dĕr ring dĕs nē'bŭ-lụng-ŭn*), a series of music dramas by Richard Wagner based on Nibelungen legends W-1
leit-motifs M-314

Ringed cowry, a shell used as money in some Pacific islands S-108

Ringed plover P-259

Ringed seal S-70

Ringed worms, or **annelids**, also called segmented worms W-180*b*
classification, *Outline* Z-229
earthworms E-137
leeches L-92–3

Ringling Brothers, founders of Ringling Brothers' circus C-237*c*

Ring-neck, a pheasant P-157

Rings, in tree trunks T-131, D-113*a*, *picture* D-113*b*

Rings of Saturn P-232, *diagram* P-229

Ringstrasse (*rĭng'shträs-ŭ*), street in Vienna V-297

Ring-tailed cat. *See in Index* Civet

Ring-tailed lemur L-94

Ringworm, a skin disease appearing in circular patches, and caused by fungi.

Rio Chama, river in New Mexico R-109

Rio (*rē'ō*) coffee C-298

Rio de Janeiro (*rē'ō dĕ zhä-nā'rō*), state on s. coast of Brazil, including the Federal District; 16,372 sq. mi.; pop. more than 2,000,000; capital Nictheroy; coffee, sugar, vegetables, cattle.

Rio de Janeiro, capital of Brazil and 2d largest city of South America; pop. about 1,800,000: R-108–9, *maps* B-226, S-208*b–c, d*, *picture* L-67*a*

Rio de la Plata (*lä plä'tä*). *See in Index* Plata River

Rio de Oro (*dā ō' rō*), Spanish possession in w. Africa s. of Morocco; comprises Rio de Oro colony (65,500 sq. mi.) besides a protectorate and adjacent occupied territory; total area, 109,200 sq. mi.; pop. 80,000; arid sandy plateau; stock-raising near coast: *map* A-42*a*

Rio Grande (*grän'dā*), river of North America forming part of boundary between U. S. and Mexico; 1800 mi. from source in Colorado to Gulf of Mexico: R-109, *maps* M-133, N-150*a, c*
Big Bend National Park N-20
boundary dispute with Mexico M-131
Elephant Butte Dam N-97, *picture* N-96

Rio Grande do Norte (*dǫ nôrt*), Brazil state, on n.e. coast; 20,236 sq. mi.; pop. about 750,000; capital Natal; cotton, sugar, wax, hides, salt.

Rio Grande do Sul (*dō sǫl*), southernmost state on Brazil seacoast, larger than adjoining republic of Uruguay, 110,150 sq. mi.; pop. about 3,000,000; capital Porto Alegre; meat, wool, fruits, rice, beans
climate B-226

Rio Muni (*mǫ'nē*), or **Spanish Guinea**, Spanish colony in w. equatorial Africa on e. coast of Gulf of Guinea; 9470 sq. mi.; pop. 220,000; chief town Bata; capital Santa Isabel on Fernando Po Island: *map* A-42*a*

Rio Negro (*nā'grō*), one of chief tributaries of Amazon; rises in Colombia; flows e. 1000 mi. through n. Brazil: *map* B-226

Rio Negro, river in central Argentina flowing e. 700 mi. from Andes in Chile to Atlantic, *map* A-279

Rio Negro, navigable river in central Uruguay flowing w. 300 mi. to Uruguay River, *map* U-262

Rio Puerco (*pwĕr'kō*), river in e. Arizona, flows into Little Colorado River, *map* A-289

Rios, Juan Antonio (born 1886), elected president of Chile 1942 C-208

Riot act, legislation passed by British Parliament, 1714, commanding that a stern order to disband and go home be read by a justice, sheriff, mayor, or other authority wherever 12 or more persons are riotously assembled; origin of expression "to read the riot act."

Rio Tinto, also **Minas de Rio Tinto**, town in s. w. Spain, 40 mi. n. w. of Seville, near source of river Tinto; pop. 10,000; great copper-mining center: C-359

Rio Verde (*vĕr'dā*), river in central Arizona, *map* A-289

Ripar'ian rights (Latin *ripa*, river bank), legal rights of owners of land bordering on or containing rivers and other bodies of water. In the case of a non-navigable river forming the boundary of a piece of land the owner commonly has rights extending to the center of the stream.

Ripley, George (1802–80), American essayist and critic, born Greenfield, Mass.; a leader in Brook Farm experiment; editor 'Appleton's New American Cyclopaedia'; important for genial, inspiring influence on literary groups.

Ripon (*rĭp'ŏn*), town in n. England 22 mi. n.w. of York; fine 12th century cathedral.

Ripon, Wis., farming and manufacturing center 75 mi. n.w. of Milwaukee; pop. 4566; Ripon College; home of the Wisconsin Phalanx, a communistic experiment (1844–50)
Republican party formed W-126

Ripon College, a non-sectarian institution at Ripon, Wis.; founded 1853; liberal arts and science.

Ripsimé, Saint, early Christian martyr put to death, according to tradition, 301 A.D. A-301–3

'Rip van Winkle', story in Washington Irving's 'Sketch Book' of a lovable good-for-naught, who, while hunting in the Catskills, drinks liquor offered him by Hendrik Hudson's legendary crew, falls asleep, and wakes 20 years after; dramatized version made famous by Joseph Jefferson: I-151
Jefferson as, *picture* D-97

'Rise of Silas Lapham, The', a novel by William Dean Howells telling of a self-made business man and his social life in Boston, of his reverses of fortune, and his resultant gain in moral strength.

Rising Sun, Order of, Japanese order of knighthood established 1875; has eight classes; conferred upon men who have rendered extraordinary services to the country.

Risorgimento (*rē-sōr-jē-mĕn'tō*), in Italian history I-162

Riss, a glacial phase I-2*b*

Riss-Würm, interglacial period I-2*b*

Ristori (*rē-stō'rē*), **Adelaide** (1822–1906), Italian tragic actress, greatest of her generation ('Mary Stuart'; 'Queen Elizabeth'; 'Macbeth'); noted for beauty and charm as well as dramatic power; made three tours in U. S.; autobiography 'Memoirs and Artistic Studies'.

Rita (Margarita) de Cascia (*rē'tä, mär-gä-rē'tä dä käs-thē'ä*; Italian *kä'shä*), **Saint** (1386–1456), Augustinian nun, born Italy; entered convent after death of husband and two sons; revered by Spanish as "Patroness of Impossibilities"; feast day May 22.

Rites and ceremonies. *See also in Index* Burial and funeral customs
Africa: admission to manhood, *picture* E-138; wedding dance, *picture* A-35
American Indian I-59, 63–6, A-292–4
buffalo dance, *picture* I-66
calumet, or peace pipe I-57
corn dance, *picture* F-11
initiating medicine men, *picture* I-65
potlatch, feast I-56, *picture* I-68
praying to Water God, *picture* I-57
Asia: Angkor Vat A-332; Siamese child loses top-knot, *picture* A-331; temple dancer of Bali, *picture* A-329
Camp Fire Girls C-41
China: burning joss sticks before Buddha, *picture* C-221*e*; Chinese marriage, *picture* C-221*e*; Chinese New Year C-220
Christmas. *See in Index* Christmas
Egypt, funeral ceremony, *picture* E-206
India: coming of age, *picture* A-327; devil dancers, *picture* I-36; honoring King George of England, *picture* I-42
Japan J-193–4: tea ceremony T-26–7, *picture* T-21
knighthood ceremony K-30
marriage M-69: China, *picture* C-221*e*
Turkey: whirling dervishes, *picture* T-160
vassal before feudal lord, *picture* F-28
Viking funeral N-166

Ritschel, Wilhelm (born 1864), American painter, born Nuremberg, Bavaria; paintings of the sea in its various moods done with sincerity and power; cloud and light effects skilfully handled ('Morea Moon'; 'Twilight at Sea'; 'Hauling up the Boats').

Rittenhouse, David (1732–96), American astronomer, born Germantown, Pa.; noted as maker of astronomical instruments; helped lay out boundaries of Pennsylvania.

Rittenhouse, Jessie Belle (born 1869), author, born Mt. Morris, N. Y.; editor several books of verse; wrote criticism ('The Younger American Poets'), poetry ('The Moving Tide'), autobiography ('My House of Life').

Ritter, Karl (1779–1859), German geographer, founder of modern science of geography; showed its underlying principle to be relation of earth's surface to nature and to man; had great influence as teacher as well as writer.

Ritty, Jacob, inventor of cash register C-91

'Rivals, The', a comedy by Sheridan telling of the rivalry between Bob Acres and Captain Absolute ("Ensign Beverley") for the hand of Lydia Languish, niece of Mrs. Malaprop; first produced in 1775; still popular.

Rivera (*rē-vä'rä*), **Diego** (born 1886), Mexican artist of modernist school; subjects are intensely nationalistic, especially murals in public build-

WORLD'S LONGEST RIVERS

NAME	CONTINENT	LENGTH IN MILES
Amazon	South America	4000
Nile	Africa	4000
Missouri-Mississippi	North America	3988
Congo	Africa	3000
Yangtze	Asia	3000
Yenisei	Asia	3000
Lena	Asia	2860
Amur	Asia	2700
Hwang	Asia	2700
Mekong	Asia	2600
Niger	Africa	2600
Ob	Asia	2500
Mackenzie	North America	2400
Volga	Europe	2325

ican football coach, born Voss, Norway F-151*d*

"Rock of Chickamauga" (Gen. George Henry Thomas) T-82

"Rock oil," or petroleum P-144–53. *See also in Index* Petroleum

Rockport, Ind., county seat of Spencer County, on Ohio River; pop. 2421; Lincoln pioneer village, dedicated there 1935.

Rockport, Mass., on Cape Ann, n.e. of Gloucester; pop. 3556; artists' colony, summer resort, fishing center; granite quarries.

Rock rabbit, or hyrax, a small mammal of the order *Hyracoidea* Z-222

Rock River, a tributary of the Mississippi in s. Wisconsin and n. Illinois, 350 mi. long: *map* I-13

Rock-rose family, or Cistaceae (*sis-tā'-sē-ē*), a family of plants and shrubs, including the rock-rose, sun-rose, and the pinweed.

Rock-salt S-15

Rock soapwort, a perennial plant (*Saponaria ocymoides*) of the pink family, native to cent. and s. Europe. Trailing, branching, soft-hairy plants with oval leaves; flowers small, starlike, bright pink or white, in loose clusters, fragrant; used in rock gardens.

Rock Springs, Wyo., city in s.w. part of state; pop. 9827; coal, livestock, oil and gas: *map* W-194

Rockville Center, N. Y., residential suburb of New York City on s. shore of Long Island; pop. 18,613.

Rock weed, a seaweed, *picture* S-72

Rockwell, Norman (born 1894), illustrator, born New York City; noted for cover designs and illustrations for popular magazines.

Rockwell Field, army air school near San Diego, Calif.: S-24

Rocky Ford, Colo., town 54 mi. e. of Pueblo; pop. 3494; in irrigated farming region: M-111, *map* C-310

Rocky Ford melons M-112, *picture* M-111

Rocky Mount, N. C., commercial town 120 mi. n. of Wilmington; pop. 25,568; cotton and tobacco trade; railroad shops; cotton yarns, plush and silk, cordage, fertilizers, lumber.

Rocky Mountain bee-plant, an important plant in the economy of the Indians of s.w. North America. *See in Index* Cleome

Rocky Mountain fir. *See in Index* Alpine fir

Rocky Mountain goat, an antelope A-218, R-122, *picture* A-219

Rocky Mountain locust G-140

"Rocky Mountain Men," a fur-trading organization F-226–7

Rocky Mountain National Park, Colo. N-22*d*
Loveland Pass, *picture* C-309

Rocky Mountains, a chain of ranges extending along east side of North American Cordilleras from Mexico to Alaska: R-123–4, *maps* N-150*a*, *b–c*, U-200, *pictures* C-309, 313
Alaska A-102
Canada R-124, C-50–1
compared with Appalachians, *chart* A-230
early explorers: Lewis and Clark L-99; Mackenzie M-12
marine fossils F-162
plant and animal life R-123
ranges and peaks R-124
United States U-182, R-123–4; Glacier National Park G-96; Yellowstone National Park Y-205–6. *See also* articles on separate states

Rocky Mountain sheep (bighorn) B-108, R-123
allied species S-104

Rocky Mountain sifflеur, or whistler, a large marmot living above timber line in the Rockies
hibernation H-289

Rocky Mountains Park, Alberta. *See in Index* Banff National Park

Rocky Mountain spotted fever, an infectious disease first identified in Rocky Mts. region; has wide range over U.S.; marked by high fever and red, spotted eruption; caused by a blood parasite which is transmitted by a tick; preventive vaccine used.

Rococo (*rō-kō'kō*) **style**
architecture A-270
furniture I-101–2, *picture* I-100

Rocroi (*rō-krwä'*), France, town near Belgian frontier, 50 mi. n. of Reims; great French victory over Spaniards 1643 in Thirty Years' War.

Rod, in long and surveyors' measure, *table* W-67. *See also in Index* Rood
origin of name W-66

Rodeheaver, Homer Alvan (born 1880), music director and writer of gospel songs, born Union Furnace, Ohio ('Song Stories of the Sawdust Trail'; '20 Years with Billy Sunday').

Rodents, or Rodentia, the order of gnawing animals R-124, list Z-229
enemies: hawks and owls B-122; snakes S-170

Rodeo (*rō-dā'ō*) (from Spanish word meaning "going around"), the annual round-up of cattle on ranches for counting and branding; also a form of outdoor entertainment built around activities of American cowboy: C-238, C-115, *picture* C-106
equipment C-113–14

Rod'erick, or Roderic, last king of the Visigoths, reigning in Spain 710–711; overthrown by Moslem invasion, which was aided by his own Gothic enemies.

Roderick Dhu, an outlaw chieftain in Scott's 'Lady of the Lake'.

'Roderick Random', semi-autobiographical novel by Smollett (1748), named from the hero, a reckless young man who has adventures abroad, at sea, and in England.

Rodgers, John (1773–1838), American naval officer, born Maryland; fought in naval war with France as first lieutenant of the *Constellation;* promoted captain 1799; fought against Barbary pirates (1802–6) and in War of 1812: N-56*e*

Rodin (*rō-dăn'*) **(François) Auguste** (1840–1917), French sculptor R-124–26
influence S-61–2

Rodin Museum, in Philadelphia R-126, *picture* P-115

Rodman, Hugh (1859–1940), admiral, U.S. Navy, born Frankfort, Ky.; commanded U.S. battleships with British Fleet in 1st World War; commanded Pacific Fleet 1919.

Rodmar, in 'Nibelungenlied' N-140

Rodney, Caesar (1728–84), American patriot, born at Dover, Delaware; early advocate of independence and signer of the Declaration; general in Revolution; president of Delaware 1778–82: D-42

Rodney, George Brydges, first **Baron Rodney** (1718–92), English admiral; defeated Comte De Grasse of France off Dominica 1782, saving Jamaica for English and destroying French naval prestige
naval ships of day N-56*d*

Rodó (*rō-dō'*), **José Enrique** (1872–1917), writer of Uruguay L-67*x*

Rodrigo, Ruy Díaz de Bivar. *See in Index* Cid, The

Rodriguez (*rō-drē'gāz*), island in Indian Ocean; dependency of Mauritius; 40 sq. mi.; pop. 8000
solitaire bird D-75

Rods, of retina E-349–50, *diagram* E-350

Rodzinski (*rō-jĭn'skĭ*), **Artur** (born 1894), American orchestra conductor, born Dalmatia; studied in Vienna; came to America 1926; conductor Los Angeles Philharmonic Orchestra 1929–33, Cleveland Symphony Orchestra 1933–43, New York Philharmonic Symphony Orchestra from 1943.

Roe, E. P. (Edward Payson) (1838–88), American novelist and Presbyterian minister, whose novels were among the best sellers of their day ('Barriers Burned Away'; 'From Jest to Earnest').

Roe, fish eggs E-192
sturgeon S-310

Roeb'ling, John Augustus (1806–69), American engineer, born in Prussia; built the suspension bridge over Niagara River (1852), and designed Brooklyn Bridge, which was built by his son, Washington A. Roebling: B-240

Roebuck, or roe-deer, a small deer (*Capreolus caprea*) of Europe and w. Asia; about 2½ ft. tall; male has small erect antlers usually with 3 tines.

Roemer (*rû'mĕr*), **or Römer, Olaus, or Ole** (1644–1710), Danish astronomer, first to measure speed of light: L-127

Roemmert, George (born 1892), American scientist and physician, born Germany; came to U.S. 1929; gave lectures and instruction in Germany and the U.S. on the projection of microscope images; founded and conducted the first microvivarium at Chicago World's Fair 1932–34: *picture* M-156*b*

Roentgen (*rŭnt'gĕn*), **or Röntgen, Wilhelm Konrad** (1845–1923), German physicist, won 1901 Nobel prize: X-199

Roentgen rays X-198–202. *See also in Index* X-rays

Roerich (*rû'rĭK*), **Nicolas Constantinovich** (born 1874), Russian painter, archeologist and writer; earlier paintings were realistic; later more decorative and monumental, finally tending toward the abstract and mystic; designed stage scenery and costumes; wrote libretto for Stravinsky's 'The Rite of Spring'; headed expedition into central Asia 1923.

Roer River, tributary of Maas. *See in Index* Ruhr

Rogation Days, the three days before Ascension Day, observed in early church by fasting and chanting of litanies in public processions; introduced by French bishop in 5th century; still observed in minor degree by Episcopal and Roman Catholic churches.

Roger de Coverley papers, in Addison and Steele's *Spectator* A-18

Rogers, Bruce (born 1870), American typographer, born Lafayette, Ind.; designed limited editions for Riverside Press 1895–1912; later consultant for publishers and for Oxford and Harvard university presses; designed Montaigne, Centaur, and other types; his masterpieces are Montaigne (folio), 'Pierrot of the Minute', and 'The Centaur'
Centaur type, *pictures* B-177, 181
printer's mark, *picture* T-174

Rogers, Henry H. (1840–1909), American capitalist, born Fairhaven,

Mass.; made vast fortune as vice-president and active head of Standard Oil Company; later influential in copper, steel, railroads, insurance, etc.

Rogers, John (1500?–55), English martyr, burned at stake for preaching against Catholicism
Bible translation B-103

Rogers, John (1829–1904), American sculptor; popular, sentimental statuette groups ('Slave Auction'; 'One More Shot'; 'The Town Pump'; 'Rip Van Winkle').

Rogers, John R. (1856–1934), American inventor, born Roseville, Ill. L-151

Rogers, Randolph (1825–92), American sculptor, born Waterloo, N.Y.; known for portrait statues and the bronze doors of the Capitol at Washington.

Rogers, Robert (1724–84?), American colonial soldier, born Dumbarton, N.H.; 1755 formed company of scouts called Rogers' Rangers for service against the French in Seven Years' War; during American Revolution organized Queen's Rangers and, later, King's Rangers for British service; main character in novel by Kenneth Roberts, 'Northwest Passage'.

Rogers, Samuel (1763–1855), English banker, poet, art patron; published at his own expense several volumes of poems which, if not brilliant, showed care and taste ('Pleasures of Memory'); friend of Wordsworth, Byron, Thomas Moore; declined laureateship.

Rogers, Will (1879–1935), American humorist and actor, born Oklahoma; first appearance in vaudeville, 1905; his free and easy manner and his shrewd, homely comments on men and affairs gave him wide popularity on stage, radio, in moving pictures, and as a writer for the newspapers; killed in Alaska on airplane flight; statue of him presented by Oklahoma to National Statuary Hall 1939.

Rogers, Woodes, English navigator who rescued Selkirk C-407

Rogers, Mount, Va., highest point (5719 ft.) in Blue Ridge Mts.

Rogers Pass Tunnel, British Columbia, 5 mi. long T-153, 154

Rog'geveen, Jacob (1659–1729), Dutch explorer, born Middelburg; carried out expeditions planned by his sailor father; imprisoned in Batavia, (1722) for trespass on rights of Dutch East India Company; later acquitted; accused by geographers of reporting under new names places previously visited by others
Easter Island discovered E-140
Samoa explored P-7

Rogue elephant E-244

Rohan (*rō-äṅ'*), **Henri, Duke of** (1579–1638), French Huguenot general, leader of Protestant party after death of Henry IV; secured confirmation (1623) of Edict of Nantes; made marshal of France, and won victory (1635) over Austrians and Spanish in the Valtelline.

Rohan, Louis René, Prince de (1734–1803), French cardinal, ambassador to Austria (1772–4) and grand almoner of France; vain, but good-natured and generous; disgraced by the affair of the "Diamond Necklace," which he was duped into buying in the belief that he was acting as agent for Marie Antoinette and would thereby win her favor.

Rohde (*rō'dą*), **Ruth Bryan Owen.** *See in Index* Owen, Ruth Bryan

Rohe, Ludwig Mies van der (born 1886), modern architect, born Aachen, Germany; influenced by Frank Lloyd Wright; combines utility and esthetic quality in vigorous, straightforward design; director of school of architecture, Illinois Institute of Technology, Chicago, after 1938.

Rohlfs, Anna K. Green. *See in Index* Green, Anna Katherine

Rohlfs, Friedrich Gerhard (1831–96), German explorer; traveled in Morocco in guise of Mohammedan; explored Sahara, visiting many regions unknown to Europeans ('Travels in Morocco'; 'Across Africa').

'Roi s'amuse, Le' (*lŭ rwä sä-mūz'*) (The King's Diversion), drama by Victor Hugo H-353
'Rigoletto' text O-232

Rojankovsky, Feodor (born 1891), Russian artist and illustrator of children's books, born Lithuania; noted for drawings of animals.

Rojas (*rō'häs*), **Ricardo,** Argentine writer L-67*j*

Roland (French, *rō-läṅ'*), hero of Charlemagne's army, celebrated in medieval legend R-126, S-303*i, o*

Roland, Jean Marie (1734–93), French politician R-127

Roland, Madame (1754–93), French social leader in Revolutionary days R-127

Rolf. *See in Index* Rollo

Rolf Boldrewood. *See in Index* Boldrewood

Rolfe (*rōlf*), **John** (1585?–1623), English colonist in Virginia; first to cultivate tobacco systematically; married Pocahontas and thus promoted friendship between Indians and English. *See also in Index* Pocahontas
begins tobacco exporting V-307

Rolland (*rō-läṅ'*), **Romain** (born 1866), French author; professor of history and music at the Sorbonne, Paris, until 1910; an uncompromising idealist and anti-militarist; became famous with the publication of 'Jean-Christophe', the story of a German musician in Paris, for which he was awarded the Nobel prize in 1915; also wrote books on musical subjects, and biographies of Tolstoy, Michelangelo, Beethoven, and Gandhi; other novels are: 'Colas Breugnon'; 'Les Caves du Vatican'; 'Pierre and Luce'; 'The Soul Enchanted', a series of five volumes
'Jean-Christophe' F-198, N-183

Rolled Gold G-114

Rolled oats B-234: irradiation of, *picture* R-15

Rolled zinc Z-217

Roller, a bird of the family *Coraciidae,* related to the Kingfishers; species in southern Europe, Africa, and Madagascar; tumbles like a tumbler pigeon.

Roller, ancestor of wheel, *pictograph* W-84*a*

Roller canary C-69

Roller process, in flour milling F-118

Roller skating, safety rules S-2*h*

Rolling mill I-142, 144, *pictures* I-140–1
brass C-361

Rolling stock, of railroads R-39–40

Rollins, Carl P. (born 1880), American typographer, advisor to the Yale University Press T-174

Rollins College, institution of higher learning at Winter Park, Fla.; established 1885; named for original donor, Alonzo W. Rollins of Chicago; developed plan of two-hour conferences instead of lecture and examination system: U-259

Rollo (*rŏl'lō*), **Rolf, Hrolf, or Rou** (10th century A.D.), Norse conqueror of what became the French province of Normandy (911): N-168, N-149

'Rollo Books', series of 28 books for children by Jacob Abbott (1803–79).

Roll sulphur S-324

Rolt-Wheeler, Francis William (born 1876), author and editor, born England; came to U. S. 1893; became Episcopal rector; lectured on scientific work of U. S. government for N. Y. Board of Education; writer of stories of achievement ('Boy with the U. S. Government' series; 'Wonder of War' series); later wrote many books on astrology.

Rolvaag (*rŭl'vägˌ*), **Ole E.** (1876–1931), Norwegian-American novelist, born Norway; professor Norwegian language and literature St. Olaf College, Northfield, Minn.; wrote powerful novels of immigrants' struggles in American prairie states ('Giants in the Earth'; 'Peder Victorious'; 'Pure Gold'; 'Their Father's God').

Roly-poly, round bottomed toy which will not upset, *picture* P-192

Roma (*rō'mä*), Italian name for Rome, Italy. *See in Index* Rome

Romagna (*rō-mäṅ'yä*), former province of Papal States, now divided into Italian provinces of Bologna, Ferrara, Ravenna, and Forlì
joins united Italy V-294

Roman'ic, modern Greek dialect G-174

Romain, Jules, Italian painter. *See in Index* Giulio Romano

Romaine lettuce. *See in Index* Cos lettuce

Romains (*rō-măṅ'*), **Jules** (born 1885), French poet, novelist and dramatist; vigorous writer; one of leaders of Unanimist movement, expressing all-embracing sympathy with humanity ('Lucienne'; 'Death of a Nobody'; 'Knock'; 'Men of Good Will').

Roman. In addition to headings under Roman (Roman architecture; Roman art; Roman history; Roman mythology), *see in Index* Rome (ancient)

Roman architecture A-261–2
ancient Rome, restoration, *picture* R-143
aqueduct at Segovia, Spain, *picture* A-235
arch A-261, A-249, *pictures* A-235, R-139
arena in Nîmes, *picture* F-170
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Colosseum R-138–40, R-146, *picture* R-139
dome, development of A-261, *picture* A-260
Forum R-138, *pictures* R-141
Hadrian's tomb (now Castle Sant' Angelo), *picture* R-139
mosaic decoration M-262
Palace of the Senators, *picture* R-139
Pantheon A-261, E-331, *picture* A-260
Pompeii P-300–1, *pictures* P-299, 301
Temple of Castor and Pollux, Rome, *picture* R-139
Temple of Saturn, Rome, *picture* A-259
triumphal arch: Arch of Titus, *picture* R-139
vault, development of A-261

EMPERORS OF ROME

27 B.C.–14 A.D.	Augustus	
14–37	Tiberius	
37–41	Caligula	
41–54	Claudius	
54–68	Nero	
68–69	Galba	
69	Otho	
69	Vitellius	
69–79	Vespasian	
79–81	Titus	
81–96	Domitian	
96–98	Nerva	
98–117	Trajan	
117–138	Hadrian	
138–161	Antoninus Pius	
161–180	Marcus Aurelius	
180–192	Commodus	
193	Pertinax	
193	Didius Julianus	
193–211	Septimius Severus	
211–217	Caracalla	
217	*Macrinus*	
218–222	Heliogabalus	
222–235	Alexander Severus	
235–238	Maximinus	
238	Gordian I, Gordian II	jointly
238	Pupienus, Balbinus	jointly
238–244	Gordian III	
244–249	Philip the Arabian	
249–251	Decius	
251–253	Gallus	
253	Aemilian	
253–260	Valerian	
253–268	Gallienus	jointly
268–270	Claudius II	
270–275	Aurelian	
275	Tacitus	
276–282	Probus	
282–283	Carus	
284	Carinus, Numerianus	jointly
284–305	Diocletian	
286–305	Maximianus	jointly
305–306	Constantius Chlorus (West)	jointly
305–311	Galerius (East)	jointly
306–312	Maxentius (West)	
306–337	Constantine the Great (West, later all)	jointly
307–323	Licinius (East)	
337–361	Constantius (East, later all)	jointly
337–340	Constantine II (West)	jointly
337–350	Constans (Africa)	jointly
361–363	Julian	
363–364	Jovianus	
364–375	Valentinian I (West)	
364–378	Valens (East)	
375–383	Gratian	(West
375–392	Valentinian II	jointly)
379–395	Theodosius I (East, later all)	

WESTERN EMPIRE

395–423	Honorius
424	John
425–455	Valentinian III
455	Maximus
455–456	Avitus
457–461	Majorian
461–465	Libius Severus
465–467	Recimir
467–472	Anthemius
472	Olybrius
473	Glycerius
473–475	Julius Nepos
475–476	Romulus Augustulus

Rosaceae (*rō-zā'sē-ē*), rose family of plants R-156

Ros'alind, in Shakespeare's 'As You Like It' A-322–3

Rosamond, Fair, in English legend, beloved of King Henry II, hidden away by him in a bower at heart of a labyrinth in Woodstock; found by jealous Queen Eleanor and forced to drink poison.

Rosario (*rō-sä'rē-ō*), 2d city of Argentina, railroad center and port on Paraná River 185 mi. n. w. of Buenos Aires; pop. over 500,000; large foreign trade: A-280*b*, *maps* A-279, S-208*c*

Rosary, a form of Catholic prayer, and the string of beads with which it is said; first used in 13th century.

Rosary College, at River Forest, Ill.; Roman Catholic, for women; founded 1918; arts and sciences.

Rosas (*rō'säs*), **Juan Manuel** (1793–1877), Argentine dictator 1835–52; bloody despot; overthrown by combination of foreign and domestic enemies: A-281, L-67*i*

Roscius (*rōsh'i-ŭs*), **Quintus** (died 62 B.C.), greatest comedian of ancient Rome. Among his patrons was Cicero, to whom he gave elocution lessons.

Roscoe, Sir Henry Enfield (1833–1915), English chemist, who isolated vanadium; worked with Bunsen in researches in photochemistry.

Roscom'mon, county in central Ireland, Connaught province, on the Shannon River; 951 sq. mi.; pop. 78,000; sheep and cattle: *map* E-270*a*

Rose, Chauncey (1794–1887), American businessman and philanthropist, born Connecticut; endowed Rose Polytechnic Institute at Terre Haute, Ind.

Rose, Uriah M. (1834–1913), American lawyer, born Marion Co., Ky.; delegate Hague Conference, 1907.

Rose, a genus of flowering plants, R-156, *pictures* R-157
apple compared, *picture* A-231
attar of P-124
development, *picture* P-241
red, myth of Adonis A-22
wild, or prairie, *pictures* N-29*a*, R-157

Rose, famille, Chinese porcelain P-331

Roseate spoonbill S-296

Roseate tern, *pictures* G-186, 187

Rose'bery, Archibald Philip Primrose, Earl of (1847–1929), English Liberal statesman, orator, and writer; premier 1894–95, and later a political power without office; wrote on Pitt, Peel, Cromwell, Napoleon, and Lord Randolph Churchill.

Rose Bowl, stadium at Pasadena, Calif.; seats about 80,000: F-151*a*, *d*

Rose-breasted grosbeak G-178, 179, *color plate* B-138
feeding habits B-122

Rose-chafer, a beetle of the June-bug family that feeds on rose blossoms.

Rose cockatoo, *color plate* P-83–4

Rosecrans (*rō'zĕ-krănz*), **William Starke** (1819–98), American Civil War general, commander of Army of Cumberland from 1862 till after defeat 1863 at Chickamauga: C-255
Murfreesboro battle F-193

Rose diamond, diamond cut with small facets D-62

Rosefish, marine fish (*Sebastes marinus*), member of rockfish (*Scorpaenidae*) family; named from bright rose-red or orange-red color; grows 15 in. to 2 ft. long; important foodfish, abundant along n. Atlantic coasts of Europe and America.

Rosegger (*rō'zĕg-ĕr*), **Peter** (1843–1918), Austrian poet and novelist; 'The Eternal Light' ('Das Ewige Licht'), one of the most popular German novels of 19th century.

Roselle, N. J., residential borough 7 mi. s.w. of Newark; pop. 13,597.

Roselle, an annual plant (*Hibiscus sabdariffa*) of the mallow family, native to tropical or subtropical regions. Grows to 7 ft.; leaves divided; flower yellow with fleshy red calyx and collar of tiny leaves. Before seed forms, calyx and leaves may be used to make jelly or beverage; also yields a fiber; sometimes called red, or Jamaica, sorrel.

Rose locust, or moss locust L-179

Rosemary, or **"old man,"** a low European shrub (*Rosmarinus officinalis*) of the mint family with opposite pungent evergreen leaves and bluish flowers; oil distilled from leaves
perfume P-124

Rosemary pine. *See* Short-leaf pine

Rosemont College, at Rosemont, Pa.; Roman Catholic, for women; founded 1922; arts and sciences.

Rose moss. *See in Index* Portulaca

Rosenau (*rō'zĕ-nou*), **Milton Joseph** (born 1869), American physician, born Philadelphia; important work in preventive medicine, disinfectants, sanitation; developed serums for meningitis and diphtheria.

Rosenberg, Alfred (born 1893), German political leader and educator of Nazi youth; exponent of modern revival of practises and beliefs of early Teutonic tribes—called "director of philosophical outlook for the Reich"; made minister for the East in December 1941.

'Rosenkavalier, Der' (*dĕr rōz-ĕn-kä-vä-lēr'*), opera by Strauss O-233

Rosenman, Samuel Irving (born 1896), judge, born San Antonio, Tex.; justice of New York supreme court; adviser to President F. D. Roosevelt.

Rosenthal (*rō'zĕn-tăl*), **Moriz** (born 1862), Austrian pianist, born Lemberg (now in Poland); pupil of Liszt; brilliant virtuoso; wife, Hedwig Kanner, also a pianist.

Ro'senwald, Julius (1862–1932), American merchant and philanthropist; born Springfield, Ill.; became head of Sears, Roebuck & Co.; gave immense sums to philanthropic projects, especially Negro education; founded Museum of Science and Industry, Chicago. *See also* Julius Rosenwald Fund; Museums, *table*

Rose of heaven. *See* Agrostemma

Rose of Japan, the camellia C-39

Rose of Jericho, or resurrection plant C-2

Rose of Lima, Saint (1586–1617), first American saint, born Lima, Peru; patroness of Latin America and Philippines; feast day August 30.

Rose of Sharon, or **shrubby althaea,** a lovely ornamental shrub (*Hibiscus syriacus*) with rose, violet, or white single or double flowers; leaves small and notched; belongs to mallow family; introduced into U. S. from Asia; name also applied to other plants; Biblical rose of Sharon was probably a kind of tulip.

Rose Polytechnic Institute, at Terre Haute, Ind.; for men; opened 1883 (organization begun 1874); mechanical, civil, architectural, electrical, and chemical engineering.

Roses, attar of P-124
Bulgaria B-270

Roses, Wars of the, contest between rival houses of York and Lancaster for English throne R-156, 158
Edward IV, first Yorkist king E-190
Henry VI loses throne H-276–7
Henry VII founds Tudor line T-149
Richard III slain R-105

Rose's metal C-177

Rosetta (*rō-zĕt'ä*), Egypt, town on Rosetta mouth of Nile River; pop. 26,000; formerly of great commercial importance; Rosetta Stone found near by: *map* E-197
Nile River mouth E-198

Rosetta Stone, key to hieroglyphic inscriptions of ancient Egypt E-202–3, *picture* E-203

Rose window, a circular window decorated with tracery; developed to great beauty in Gothic architecture
Reims Cathedral, *picture* C-100

Rosewood, hard, close-grained, fragrant wood of Brazilian tree of the bean family; also wood of African tree prized in cabinet making.

Rosh Hashanah (*rōsh hä-shä'nä*). *See* New Year's Day, Jewish

Rosicrucian Order, an international fraternity officially called the Ancient Mystic Order of Rosae Crucis (or AMORC); its emblem is a cross with a single rose in the center; existence traced back to 12th century in Europe and earlier in Orient; in America since 1694; *operates on lodge system* and teaches metaphysical-scientific philosophy of "practical arts and sciences." American headquarters, San Jose, Calif.

Ros'in, a resin R-78. *See also* Resins
cement for utensil handles C-128
varnish uses P-32*b*

Rosinante (*rō-zē-năn'tā*), in Cervantes' 'Don Quixote', the hero's famous steed C-136

Rosin-weed, a "compass plant" C-327

Roskilde (*rŭs-kil'dŭ*), Denmark, old town 16 mi. w. of Copenhagen on Zealand Island; pop. 16,000; capital until 1443; cathedral with tombs of early Danish kings.

Ros'lyn, New York, village 18 mi. n.e. of Brooklyn; pop. 972; home and burial place of W. C. Bryant.

Rospigliosi (*rōs-pēl-yō'zē*), noble Roman family; Pope Clement IX was its most famous member
palace in Rome R-145

Ross, Alexander (1783–1856), Canadian fur trader, author, born Scotland; emigrated to Canada 1805; joined Pacific Fur Company 1810 and helped to found Fort Astoria on Columbia River; joined Hudson's Bay Company; 1825 settled in Red River District ('The Red River Settlement'; 'Adventures of the First Settlers on the Oregon or Columbia River').

Ross, Betsy (1752–1836), traditional maker of first American flag, the Stars and Stripes F-91–2
home, *picture* P-159

Ross, Edward Alsworth (born 1866), American sociologist, born Virden, Ill.; professor at University of Wisconsin after 1906; author of *many books on sociology.*

Ross, George (1730–79), signer of Declaration of Independence as Pennsylvania delegate; born Newcastle, Del.

Ross, Sir James Clark (1800–62) British admiral and polar explorer; determined the position of the north magnetic pole, 1831, when accompanying his uncle, Sir John Ross, in his search for a northwest passage: in 1840–43 headed expedition to Antarctic: A-217
discovers Ross Sea P-283

Ross, Sir John (1777–1856), British explorer, born Scotland; rediscovered Baffin Bay in 1818

when he commanded an expedition for discovery of northwest passage; 1829 made another attempt to find northwest passage but failed and was ice-bound for four years.

Ross, John (1790–1866), Cherokee Indian chief (Indian name Cooweescoowe), born Georgia; Scottish father had him educated at home by tutor and at Kingston Academy; president of Cherokee National Council 1817–26; often delegate to Washington, opposed cession of land and westward migration; chief of Cherokee nation from 1839 until death.

Ross, Nellie Tayloe (born 1880), first woman governor of an American state; governor of Wyoming 1925–27 to fill unexpired term of her husband, William B.; made director of United States mint 1933.

Ross, Robert (1766–1814), British major general; captured Washington, D.C., in the War of 1812: W-10

Ross, Sir Ronald (1857–1932), British physician, discoverer of life-history of malaria parasite M-270, P-46

Rossbach (*rŏs'bäĸ*), **battle of** (1757), in which Frederick the Great defeated the French in the Seven Years' War; named for village 25 mi. w. of Leipzig, Germany.

Ross Dependency, coasts of Ross Sea and adjacent islands in region; created dependency by Great Britain 1923; under jurisdiction of New Zealand; includes rich sea life.

Ros'sel Island, in s. Pacific Ocean s.e. of New Guinea, part of Louisiade Archipelago.

Rossellino (*rŏs-sĕl-lē'nō*), **Antonio,** common name of Antonio Gambarelli (1427–79), Italian sculptor; work influenced by Donatello: S-57

Rosset'ti, Christina Georgina (1830–94), English poet, sister of Dante Gabriel Rossetti R-158

Rossetti, Dante Gabriel (1828–82), English poet and painter, brother of Christina Rossetti R-158–9
Pre-Raphaelites R-158–9, P-23
Swinburne and S-346
William Morris and M-261

Rossetti, Gabriele (1783–1854), Italian poet and critic, father of Christina, Dante Gabriel, and William M. Rossetti R-158

Rossetti, William Michael (1829–1919), brother of Christina and Dante Gabriel Rossetti; painter, poet, editor, and biographer; edited *The Germ,* a magazine of the Pre-Raphaelite group.

Ross Ice Barrier, or **Great Ice Barrier,** also called **Ross Shelf Ice,** in Antarctic region A-214, P-283, *map* A-215, *picture* A-217

Rossini (*rŏs-sē'nē*), **Gioacchino Antonio** (1792–1868), Italian composer ('William Tell', opera; 'Stabat Mater', sacred composition)
'Barber of Seville' O-229

Rossiter, Thomas Prichard (1818–1871), American portrait, historical, and religious painter, born New Haven, Conn. ('Washington and Lafayette at Mount Vernon, 1776'; 'The Prince of Wales and President Buchanan').

Ross' Landing, in Tennessee C-157

Rosso (*rŏs'sō*), **Medardo** (born 1866), Italian sculptor; influenced by Rodin: S-62

Ross Sea, in Antarctic region A-214, *map* A-215, *picture* A-217
Amundsen's base P-284
Byrd's base B-289
discovered by Ross P-283

Rostand (*rō-stäṅ'*), **Edmond** (1869–1918), French dramatist; his play 'Cyrano de Bergerac' deals with real character of that name; 'L'Aiglon', with the young king of Rome, son of Napoleon I; 'Chantecler' is a satire in which the characters are barnyard fowls: D-96

Rostock (*rŏs'tŏk*), Germany, largest city of Mecklenburg and one of chief Baltic ports; 95 mi. n.e. of Hamburg; pop. 125,000; famous university; an old Hanse town: *map* G-66

Rostov-on-Don (*rŏs-tŏf'*), also **Rostof,** important commercial center of s. Russia on Don River 20 mi. from Sea of Azov; pop. 510,000; grain trade, flour mills, iron works, annual fair: *maps* B-154, E-326*e*

Roswell (*rŏz'wĕl*), N. M., city 177 mi. s.e. of Santa Fe; pop. 13,482; health resort; farming, dairying, stock raising, mining, flour mills: *map* N-97
irrigation project N-97–8

Rot, name given to a number of plant diseases caused by parasitic fungi and bacteria.

Rot, or **putrefaction** B-12, B-116
fermentation similar F-24

Rotary Clubs, organizations established for the purpose of making practical application of the ideal of service to business and professional life. The first Rotary Club was formed in Chicago in 1905 by Paul P. Harris. Rotary International was organized in 1912 and now includes clubs in many parts of the world. Active membership is limited to one representative of each business, profession, or institution in a community.

Rotary converter, or **rotary transformer.** *See* Converter, rotary

Rotary printing press P-348, *picture* P-347
stereotype plates for S-287

Rota'tion, in physics P-192
centrifugal force C-134, P-192
gyroscopic principles G-191

Rotation of crops C-367. *See also in Index* Crop rotation

Rotation of planets, *table* P-231. *See also* Earth, *subhead* rotation.

R.O.T.C. *See in Index* Reserve Officers' Training Corps

Rotenone (*rō'tē-nōn*), insecticide obtained from certain plants of bean family. U. S. supply comes chiefly from the *derris* of the Far East, the *cubé* of Peru, and the *timbo* of Brazil, which are imported in the form of dried roots: S-263

Roth, Frederick George Richard (born 1872), sculptor, born Brooklyn, N. Y.; distinguished for equestrian and other animal sculpture.

Rothamsted, scientific agricultural experiment station, founded 1843 by J. B. Lawes on his estate near Harpenden, England; research on plant and soil nutrition.

Ro'thenburg-on-the-Tau'ber, old town in Bavaria, Germany G-69

Rothenstein, Sir William (born 1872), English painter and author, known for portraits and illustrations ('Sir Rabindranath Tagore'; 'Augustus John'; 'Morning at Benares'); among his published works are 'Life of Goya', 'Twenty-four Portraits', and 'Men and Memories'.

Rotherham (*rŏth'ĕr-ăm*), England, manufacturing town 6 mi. n.e. of Sheffield on Don River; pop. 70,000; iron and steel products, glass, pottery.

Rothermere, Harold Sidney Harmsworth, first Viscount (1868–1940), British newspaper proprietor and philanthropist, brother of Viscount Northcliffe with whom he was associated; newspapers include *Daily Mail, Daily Mirror, London Evening News;* air minister 1917–18.

Rothschild family, Jewish banking family of German origin; includes Meyer Amschel or Mayer Anselm (1743–1812), Anselm Mayer (1773–1855), Solomon (1774–1826), Nathan (1777–1836), Karl (1788–1855), Jacob or James (1792–1868), Lionel (1808–79), Nathan Meyer (1840–1915), etc.: R-159, F-188

Ro'tifers (*rotifera*), the "wheel animalcules" W-180*b*, Z-227

Rotogravure, printing process E-298, N-109

Rotor
armature of electric induction devices E-218
autogiro and helicopter A-86
centrifugal machinery C-134
speedometer, *picture* S-244
turbine, *picture* T-155

Rotorship. *See in Index* Flettner, Anton

Rotos, laborers in Chile C-207, *picture* C-207*d*

Rotten boroughs, in English politics, P-78

Rot'terdam, chief seaport and 2d largest city of the Netherlands; pop. 580,000: R-159, *map* B-87, *picture* N-68

Rou. *See in Index* Rollo

Rouaix (*rọ-ĕ'*), **P.** (born 1850) French furniture expert and art critic
quoted on period furniture I-99, 101

Rouault (*rọ-ō'*), **Georges** (born 1871), French artist, modernist; early paintings gross, powerful, sardonic, later work more decorative with more harmonious relation of color and form; noted for lithographs and engravings of work of other moderns ('Little Olympia'; 'The Bride').

Roubaix (*rọ-bĕ'*), France, manufacturing town in n. near Belgian border; pop. 105,000; woolen and linen goods, carpets; taken by Germans 1914; regained by France 1918; captured by Germans 1940.

Rouen (*rọ-äṅ'*), France, important manufacturing and trading city on Seine River, 75 mi. n.w. of Paris; pop. 125,000; ancient capital of Normandy; occupied by Germany 1940: N-149, *map* E-326*d*
cotton cloth F-176
Joan of Arc burned J-220
Joan of Arc statue, *picture* F-174
pottery P-331
seaport S-76
tower, *picture* J-220

Rouge, in glass manufacture G-102

Rouget de Lisle (*rọ-zhĕ' dŭ lēl*), **Claude Joseph** (1760–1836), French song-writer; composed 'Marseillaise': *picture* N-26

Roughage, in diet F-146, H-372

Rough-legged hawk H-246, B-288, *picture* H-246

Roughnecks, circus laborers C-237*e*

Rough oxeye. *See in Index* Heliopsis

Rough Riders, regiment of cavalry in Spanish-American War, led by Theodore Roosevelt: R-148, S-235

Rough-winged swallow, bank swallow, or **sand martin** S-332

Roumania. *See in Index* Rumania

Round, in archery A-255

Round, or **canon,** in music M-310
'Sumer is i-cumen in' M-310: music M-309

Round clam, or **quahaug** C-259
shells used for wampum S-108

Round-eared elephant, or **pigmy elephant** E-248, 250, *picture* E-246

CZARS OF RUSSIA

HOUSE OF RURIK

1462–1505	Ivan III, the Great
1505–1533	Vassili Ivanovitch
1533–1584	Ivan IV, the Terrible
1584–1598	Feodor Ivanovitch
1598–1605	Boris Godunof
1605–1613	Time of the troubles

HOUSE OF ROMANOF

1613–1645	Michael
1645–1676	Alexis
1676–1682	Feodor Alexiévitch
1682–1689	Ivan V, Peter the Great (jointly)
1689–1725	Peter the Great (alone)
1725–1727	Catherine I
1727–1730	Peter II
1730–1740	Anna Ivanovna
1740–1741	Ivan VI
1741–1762	Elizabeth
1762	Peter *III*
1762–1796	Catherine II
1796–1801	Paul I
1801–1825	Alexander I
1825–1855	Nicholas I
1855–1881	Alexander II
1881–1894	Alexander III
1894–1917	Nicholas II
[1917	Czarist rule overthrown]